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In Two Sections
Section 1

Testing of Inventories

and

Setting Up—

Research and Development Costs

Standard Costs

Overhead Rates

Service Expense

and

Forward Planning

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Significance of Company Forward Planning

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SOUND FORWARD PLANNING, while not a new art, is certainly a necessary one. Automation, higher capital costs and longer lead times, when linked to the dynamic character of our economy, emphasize the need for advance knowledge of the results which can be expected from alternate market approaches, capital expenditures and new products. Strategic planning in all its phases has become not merely helpful but vital to business health. What are the elements of an integrated forward planning program? In this age of space and missiles we might well think of the planning required to hit the moon with a rocket, which someone has likened to standing with a small rifle on the edge of a merry-go-round revolving at tremendous speed and, simultaneously, attempting to hit a speeding railroad train a mile away. You must pull the trigger at precisely the right time.

How can we hope to achieve this kind of precision as we analyze the facts that must be considered in planning for the future development and improvement of a business? First, and quite apart from the details of either the long-range or the current operating plans, we need to establish corporate goals and objectives. Answers to the questions "What kind of a business do we have?" and "What kind of a business do we want it to be?" should stimulate the establishment of corporate targets.

Among the factors to consider in developing company objectives are market position, sales volume, efficiency of production, research and product leadership, new products and new markets, new sources of raw materials, employee performance and attitude, public responsibility, profitability, and, certainly, a clear definition of the total corporate return on assets used. Obviously, these objectives should recognize and reflect the company's particular strengths and weaknesses. Only when the corporate goals and objectives are firmly established can we approach our program for an integrated forward corporate plan. This plan includes three principal segments:

1. A long-range plan.
2. A short-range operating plan.

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3. Control of costs, and measurement and evaluation of results in comparison with the plan.

Long-Range Planning—Its Nature and Services

Essential to the long-range plan is the use of a separate economic forecast. What is the expected economic climate in the world, in the United States, and in the states in which you are in business? What is the outlook for the industry in which you operate, and how does your company stand today within this industry? Most long-range plans are based on fairly long-term economic trends rather than forecasts of short-range changes in the cycle of business activity. We want to know the economic and technological environment in which the company will have to compete.

Based on forecast market demand, the long-range plan will include sales volume objectives, manufacturing capacity and supply, and transportation requirements. In a particular industry it will also include a forecast of the amount of raw material anticipated from own production or scheduled to be purchased. This quantitative information must be worked into a pattern that reflects company objectives as closely as possible. The levels of capital expenditures, forecast profits, and future cash position will be related to these data. In some companies the primary long-range planning problem focuses on either research, development and market plans for new products, or modification of existing product lines. Finally, the data comprising the long-range forward plan should be flexible; in other words, they should be susceptible to analysis, re-arrangement and manipulation.

Planning is undoubtedly expensive. Yet it offers enormous savings if, through careful evaluation of alternatives, we can successfully narrow the area of decision on forward programs. Elimination of a single doubtful course of action in the planning stage can forestall the unproductive expenditures of thousands, even millions, of dollars in the implementation stage. The careful weighing and selection of alternatives on new programs serve to balance return versus risks. In another sense, a good forward plan high-lights those alternatives best related to the talents, facilities and funds of the company. It is at this point that new opportunities for markets, products and processes should be considered. The scope and dimensions of such a long-range forward plan must be tailored to the company budget, size of operations and the need for a total integrated approach. Most plans in current use cover three or five forward years. Some also extend to ten, fifteen or twenty years.

It is both challenging and frustrating to realize, as one must, that the moment management decides on a long-range plan, it is obsolete. Outside cir-

cumstances and changes within the company make this unpleasant statement a reality. This does not, however, minimize the strong advantages of forward planning. The discipline involved in taking a long look ahead, of actually charting a forward program, of determining the best overall course of action, far outweighs the costs and difficulties of doing this work. Such recognition of potential problems before they arise cannot fail to be advantageous. Nothing destroys efficiency more than repeated attempts to avoid or minimize trouble with last-minute "crash" action. On the other hand, corporate agility in the face of completely unforeseen circumstances should be markedly improved with sound forward planning.

Short-Range Annual Operating Plan

Intimately related to the long-range plan is the short-range annual operating plan for the coming year. If we assume that management's corporate objectives have been translated into a long-range three-year or five-year forward plan, we can then develop an annual operating plan based on the policies, programs and assumptions already established.

The short-range plan is an effort to spell out in specific terms those elements of the long-range plan we hope to achieve in the next twelve months. Like its larger brother, the short-range plan sets forth, first, the physical dimensions of the business: the barrels, gallons, pounds and other units of production, manufacture, distribution and sale. Directly related to the physical plan are the costs and expenses of doing the job we have projected. This requires a translation of the volume data in terms of revenue, cost of goods sold, expense, and income before taxes. We forecast a profit profile of the business for each month or quarter in the calendar year ahead. This profile takes into consideration expected capital expenditures approved for the period, including such elements as loans, working capital, and one-time expenses. This provides a complete cash-flow picture.

Here again, the building blocks of the short-range plan should be capable of rearrangement. This should facilitate any re-study necessary to consider alternatives of either a financial or operating nature in next year's program. The elements of the short-range plan should be arranged so that desirable capital expenditures and new programs can be balanced against available cash. By the same token, it should be possible to balance the potential of increased sales and enlarged markets against capacity and product supply, all in the total corporate interest. The program for each operating area and department is likewise balanced with centralized policy for direction and control.

The short-range operating plan should be developed from the bottom up, with broad direction, policy guidance and assumptions provided from the top. A plan reasonable of attainment and capable of change requires full coordination with all affected managers and departments. Such a plan is almost essential under a policy of decentralization and delegation of operating authority that permits measurement of performance against established targets.

Once the short-range operating plan has been digested and approved by top management, it becomes the blueprint for the next year's operations. To the highest degree possible, our operating plan should represent a clear delineation of responsibility for action and accountability for results.

Measurement of Performance and Evaluation of Results

Cost control in the immediate future is also served by the short-range operating plan. This control is effected by executive review and decision to determine the components of the short-range profit plan that are acceptable to management. Transmission of acceptable targets from headquarters management to the field organization is the initial step in establishing the profit profile within which costs and revenues are expected to fall.

Control statements spotlight performance and measure results against the short-range plan. Their purpose is to answer the question: what are the reasons for success or failure in attaining the plan's goals? Good control statements, regardless of the techniques used, should point up deviations from the plan simply, clearly and promptly. This focuses management's attention on the exceptions and the problem areas first. The control report should anticipate questions, with brief comments on the reasons for deviation from the plan. Where significant, action to correct the deviation should be indicated.

Equally important is an analysis that compares the rate of return and results of specific capital projects and programs with the original forecast. The financial and operating advantage of each major capital expenditure should be demonstrated, after the fact, through volume analysis, the payout period and the return on investment.

Analysis; Corrective Actions

Another consideration is whether the long-range and the short-range operating plans are to be revised between planning periods. Usually the long-range plan is revised annually, while practices for the short-range operating plans range from annual to monthly revisions. There are valid reasons for either approach, depending on the company's operating pattern and control techniques.

The long-range plan, the current operating plan, and the means for measurement of performance and results are of equal importance. Continuous feedback of the information from one area to the next smooths the way for intelligent inter-action among them. The entire program stands to benefit from this dove-tailing process. Changes in direction in the long-range plan will obviously affect the short-range operating targets. Likewise, a change in the rate of progress of the short-range plan affects the timing of achievement on long-range goals. Analysis of the reasons for failure to reach planned objectives will often point up problems that need to be restudied and resolved in the next planning cycle.

Controller's Role Is Central

Finally, what is the role of the controller in helping to develop these results for management? Certainly the decisions on long and short-range programs and on establishing and attaining objectives are the clear responsibility of line management. However, the forward-looking controller, be he on the corporate, company or division staff, will serve as adviser on many of these decisions. The controller is a focal point of responsibility in the profit plan effort through development of the procedures and instructions for the plan, through assembly and summary of the plan data and, finally, in the analysis and interpretation of what the plan means to management. The role of the "controller's challenge" or questions to management about the plan is one means of assuring cohesiveness and balance in the total program. In addition, special studies are often needed to show the profit and loss effect of alternatives in the plan. Clear-cut definitions of volumes, expenses, income and financial elements included in the plan can make it far more useful to all levels of management.

In most companies a majority of the tools, techniques and talents for collecting this information fall within the controller's function. In the area of techniques, there is a broad opportunity to do a better job on integrated forward planning. Actual achievement of the objectives of long and short-range planning, decentralized operations and centralized control of policy and performance require that the controller or the financial staff develop a program of management information fully geared to these objectives.

"Total Systems" Approach to Management Information

While I am somewhat conservative on complete mechanization of management information, I am convinced of the value of a "total systems" approach to this question. Today, in contrast to five years ago, a balanced combination

of the electronic computer, improved data transmission, tabulating equipment and skillful presentation of the facts provides the means for handling all of the elements of corporate planning within the confines of one integrated system.

When the techniques of operations research are added to the capability of a high-speed electronic computer, it is possible to create extremely useful mathematical models of operating situations. Application of these models to the planning program permits us to evaluate and test in advance the impact of a large number of operating alternatives. This approach has been applied with considerable success to problems of supply and distribution, transportation, and refinery programming. Thus, in truth, we stand at the threshold of a multitude of new techniques for improving the quality, depth and validity of our forward-planning data.

Ultimately, men—not machines—still make the final decisions. And the real purpose of corporate planning is to facilitate decision-making by top management.

To summarize, in making the integrated forward plan we:

1. Develop corporate objectives.
2. Study the economic situation.
3. Prepare a long-range plan for the next five years.
4. Prepare a one-year short-range operating plan, evaluate and select the best alternative programs open to the company in the coming year.
5. Control costs, measure volume and appraise profit performance against the short-range plan; take necessary corrective action.

This effort should help to develop more capable executives, improve understanding of corporate objectives, create operating targets that are understood and accepted up and down the management stream, and increase the return on assets used. Each of these accomplishments promotes the overall success of the company.

Repaired or Rebuilt — It Has To Be Accounted For

by WINSTON R. WILLMERT

THE MANAGER of many a company has looked out from his office one day and realized for the first time that he is in the repair business. For the first time, with a comprehending view, he sees a department or a floor or even a whole building, given over to the repair of his product. Maybe repair is not quite the word. Something like rebuilding probably comes closer to describing the operation. However, because repair is in such general use, we will stay with the term.

Every manufacturer who sells a mechanical device that can be slipped into a shipping carton will, sooner or later, get some of them back. He must provide his customer with a repaired device, either the same one the customer sent in or an identical one in exchange. Although the repaired item is frequently as good as a new one—indeed, the two are often indistinguishable—the manufacturer must sell the repaired device at a substantial discount. Granted, he gets much of his material and manufacturing labor free in the form of reusable parts, but he must also spend time in tear-down and part refinishing, which he does not do on a new device.

When new products or new devices go into the market, it is some time—months and years—before they begin to trickle back for repair. At first they are repaired on a kind of catch-as-catch-can basis. Maybe the disassembled parts are brought to the regular line and scheduled between lots of new production. Maybe a bench is set aside in a corner of the factory for repair items. Or repair work may even be jobbed out to small shops. Eventually, though, the volume of repair business levels off at a rather sizable percentage of new production. And so the manager is forced to the conclusion that, like it or not, he is in the repair business. Once having accepted this fact, it is his responsibility to show a profit on this part of the business. If company policy or the competitive situation is such that he can not show a profit, the responsibility remains to operate with as little loss as possible.

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Repair Accounting Is Different from New Product Accounting

By and large, any company's accounting system has grown up around the manufacture of new products. The accounting for repaired products is not the same as that for new production. As the repair business gets larger and larger, it becomes a problem to try to fit repair accounting into the new production accounting framework. Hence, somewhere along the line, the manager will request a new accounting system for repaired items. He will not be interested in many of the figures that interest him in new product accounting. Basically, he will want to know how much it is costing to repair each device. He will want to know this (and not much more) so that he can re-claim these costs by charging as nearly adequate a price as is possible.

Now let us put ourselves in the shoes of the accountant who has been assigned the job of developing a system for repair accounting. First of all, the amount of material used in new production is the same each time the device is produced. The same labor and machine operations are used each time, also. This consistency makes a rigid cost accounting system possible. In repair production, things are different. The amount of new material used to repair a device one time will differ from the amount used another time. Also, the amount of labor and the number of machine operations often differ from time to time.

Noting the difference between repair business and new product business, it becomes apparent that the accounting should also be different. After considering many factors bearing on the problem, there remain three on which the type of an accounting system seems to hinge. Stating these major factors in the form of questions and answers, the accountant can begin to "zero in" on the final solution.

The answers quoted here reflect the operations of a medium-to-large company. The type of product is such that the customer does not ordinarily carry a spare. In short, the example we are going to use will fit the greater share of companies whose repair volume warrants a repair accounting section in their general ledgers. Specific products (to help provide a frame of reference) are: electric razors, electric appliances, gas engine generators, or refrigerator compressor units.

1. Question: How large a repair volume can be expected?

   Answer: It will be large enough to set aside a section of the plant as repair item work space. Tools and equipment specifically for repair work will be warranted. There will be several full-time employees engaged. However, the vol-

ume of repair business will be small in relation to new product business, and small enough to fit into one physical location.

2. Question: What records are necessary for inventory control?

   Answer: With all repair work in one area, complicated inventory records are not necessary. The foreman can tell, by looking over storage areas and work benches, whether inventories are increasing or decreasing appreciably. Accounting records that indicate general increases or decreases in inventory will be sufficient.

3. Question: How important is expediting of customer service?

   Answer: In the type of business under consideration, it is extremely important. The customer needs the item in good running order immediately, which has given rise to the widespread practice of returning to the customer not his own item, but a similar one that has been repaired. By this means the customer gets excellent service and, on the other hand, the manufacturer is enabled to operate efficiently, using a backlog of work. The feast-or-famine type of operation, necessitated by repairing the same item that the customer sent in, is absent.

To summarize the requirements to be met by the repair accounting system, we find that (1) repair volume is sufficient to require a work space of its own, (2) inventory records need not be elaborate and work-in-process inventory can be flexible and (3) the customer will get an already repaired item in exchange for his own.

Three Different Systems Are Available

What kind of an accounting system best fits these requirements? In selecting an accounting system to fit this size and kind of repair business, let us take a look at the systems available.

Standard cost system is the first one to be considered. The basis for standard costs, of course, is the predetermination of the inventory value of each component part of a device. As each part is completed, its value is added to the book inventory. If the actual cost of the component is higher or lower than the predetermined value, the difference is put into a variance account. The advantages and the disadvantages of the standard cost system may be presented as follows:

ADVANTAGES

1. A proportionate amount of costs can be written off against a proportionate amount of sales.
2. A very accurate measurement of the amount of inventory on hand is given.
3. The cost of repairing each type of device is computed.

DISADVANTAGES

1. The system is expensive.
2. Once a standard has been set, it is costly to change it.
3. As the actual cost of the device changes, the variance ratio gets out of hand without corresponding standard cost revision.

To get the full benefit of a standard cost system in the repair business, several problems must be taken care of. The proper allocation of labor, burden and material costs has to be established. In turn, each one of these items requires considerable accounting in order to apportion the costs correctly.

Let us examine labor costs. To get an adequate standard, it may be necessary to make a study of the time it takes to do each repair job, unless there are definitely repetitive sequences. There are several methods of time study, from timing each individual operation to the statistical approach of ratio delay. All are relatively expensive. A further cost, and a continuing one, is the record which has to be kept on what the operator does. Again, this can vary from a labor ticket or time ticket on each operation to a simple count or weighing operation for the whole day's production. In any event, it is comparatively costly to set standards and to record output production against them. Although the expense of a standard cost system is high, part of the cost can be offset by increased efficiency through having accurate records of individual operator performance available. Among industrial engineers, a rule-of-thumb estimate is that performance can be improved by one-third after a job is time-studied. If the volume of work per type of device is high enough, this increased efficiency may more than offset the added cost of accounting records.

In strange contrast to normal accounting practice, the application of burden or overhead costs in repair accounting is usually less complicated than figuring up of direct labor and material. This turn of events comes about because, since the repair business is confined to a single location, only one burden rate is to be established. The only thing to be done is to accumulate burden costs for the entire department and relate the total to the standard labor on each device.

The handling of material under the standard cost system is more complicated for repair accounting than in new-product standard costing. When a device breaks down and is returned to the manufacturer for repair, the necessary repair parts are not always available from previously returned items. For example, a device having unusual wear on one particular part will require a constant infu-

sion of an identical new production part. Therefore, in a repair department, both new and used parts must be accounted for. This requires that a standard be set, not only on new material but also on material salvaged from the devices to be repaired. To have only a single standard for both new and used material is a possible solution, but this means that new material, removed from the regular production inventory, would have to be de-valued to the used material standard or the latter must be equal to that for new material, a doubtful practice.

Another consideration before adopting a full standard cost system is the volume of repetitive operations on each device to be repaired. The standard cost system will be further complicated if the policy of the company is to repair only what is damaged. It is best, if adapted to a system, to tear down the damaged devices and completely reassemble them in the same manner as the new production. In order to be accepted by the customer in place of his own, the replacing device must be in pretty good shape. It must be cleaned, painted and should look almost like new. The quickest way is to rebuild and refurnish the whole device, not just the part which is not operating. It is for this reason that the business of repairs has swung around more and more to a business of rebuilding.

Current write-off system, in which the costs of operating the repair department are written off in the period in which they occur, is the second system of accounting for repair items. This means that the labor, burden and material costs are charged directly to an expense account. In other words, they are expensed and the profit and loss statement reflects cost when it happens. There is no inventory account to absorb the fluctuations in the size of the repair department payroll. The number of repair department personnel may be above normal to handle a backlog of returned devices although sales of repaired devices are at a low ebb. And this is exactly the way it will look on the company books under a current write-off accounting system. Sales or income dollars will be low while expenses are high. Repair department profit will be correspondingly low for the period. Or, the reverse may happen. Sales may be high with repair expenses less than normal. The repair department profit and loss statement is again distorted, this time with profits shown greater than they actually are.

Again, the advantages and disadvantages of the method are compared below:

ADVANTAGES	DISADVANTAGES
1. Simplified record-keeping in the shop.	1. Distorted profit levels as result of seasonal fluctuations in repair sales.
2. Small amount of indirect labor necessary for this type of accounting.	2. The accounting records will not indicate whether the amount of

work-in-process on the floor at any one time is increasing or decreasing.

One of the remedies to the work-in-process problem is the establishment of perpetual inventory records kept on the floor. These records, although not a part of the accounting system, would still indicate the number of new and used parts in stock as well as partly assembled or disassembled devices.

It appears that this system will only fit a very small repair business. In such a business, the foreman in charge can determine by observation, with a fair degree of accuracy, the amount of costs involved in the repairing of any particular type of device. He does not need the greater accounting detail which a large repair department entails.

Job cost system is the last type of available systems. Its distinguishing characteristic is the job cost ticket which accompanies each device or batch of devices. Each hour of direct labor and each bit of material used are recorded on this ticket. Burden or overhead is distributed to each ticket, usually on the basis of direct labor.

This is the most accurate of systems presented, but it suffers from the great amount of paper work involved. While paper work in the office can be tolerated, an undue amount in the shop automatically works against any system.

ADVANTAGES	DISADVANTAGES
1. Proportionate costs can be written-off against sales.	1. Every item or group of items going through the factory must be tagged with a job number.
2. Repair costs for each type of device are established in the most accurate way.	2. High expense of operating a job cost system.
3. With more accurate costs it is easier to determine repair selling prices.	
4. By summarizing the costs on jobs in process, an accurate measure of in-process inventory is available.	

Selecting and Operating the Best Fitting System

The repair business, as outlined, will support an accounting system above the minimum cost but will not warrant one that is decidedly expensive. This limitation of costs rules out the job cost system and certain portions of the standard

cost system. Also, because, due to the seasonal fluctuation of the repair business, a very desirable feature is write-off of costs proportionate to sales, limits are set to the use of the current write-off system.

At this point, it begins to appear that a middle-of-the-road policy should be adopted on repair accounting. Such a policy can incorporate some of the aspects of the standard cost system as well as some from the direct cost system. In combining parts of these systems we establish what we call, rather unimaginatively, a modified standard cost system. Before getting into the details of how it operates, a look at the list of objectives might be helpful:

1. It is advisable to write-off proportionate costs against proportionate sales.
2. A desirable feature is a book work-in-process figure to indicate whether inventory is increasing or decreasing.
3. Actual costs are desirable on each type of device to help set realistic selling prices and to get a realistic profit and loss statement.

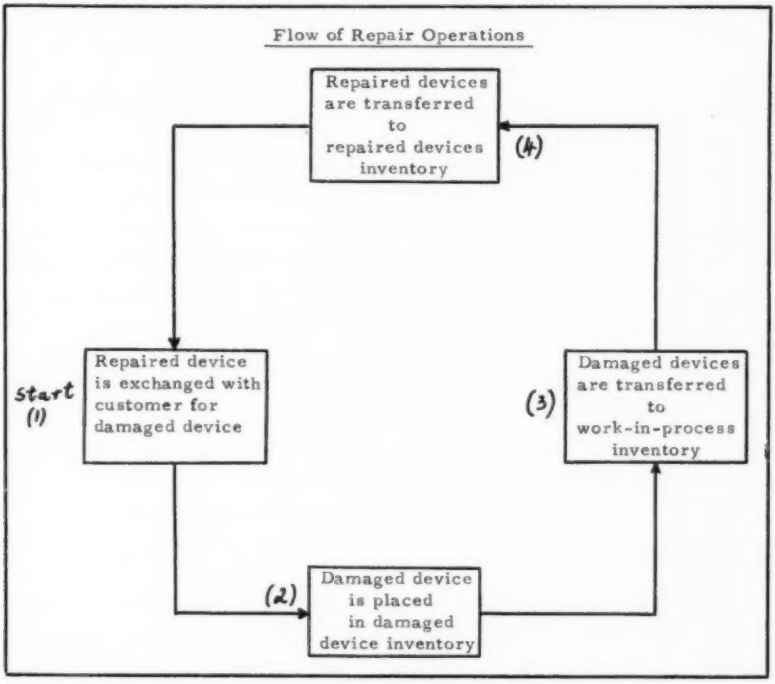
Flow of Repair Operations
Repaired devices are transferred to repaired devices inventory
(4)
start
(1)
Repaired device is exchanged with customer for damaged device
(3)
Damaged devices are transferred to work-in-process inventory
(2)
Damaged device is placed in damaged device inventory

EXHIBIT 1

To determine how this system works, let us follow the flow (Exhibit 1) assuming that the repair business is divided into three different types of inventory: (1) an inventory of unrepaired devices, (2) a work-in-process inventory, (3) a repaired device inventory. A physical movement of the device from one inventory to the other follows the course shown in the exhibit.

It will be noted that, at the time the customer returns the damaged device, he is given a repaired device. The damaged device goes into the damaged device inventory. By taking a sample of, say, 500 devices and determining the entire cost of tearing them down, building them up, adding new parts, and putting the 500 into the repaired inventory, we can determine the standard costs of repairing a single device. Assume that, through this study, we have determined the cost of repairing one unit of Device A is $2. This, then, becomes the standard cost for repairing this item.

After having made the study, we work in the reverse direction to determine the value of work in process. For example, if, during the given month, costs are incurred within the repair department to the extent of $5,000, we can assume that either 2,500 units have been completely repaired or the number of units in the process of being repaired has increased or decreased. We know by physical count that the number of units moved from the in-process area to the repaired stock areas was only 2,000. Work-in-process inventory has, therefore, increased by $1,000.

It is one step further now to the profit and loss statement. Assume that 2,000 Device A's were sold to customers during the month for which the repair cost was $4,000, that repair billings to these customers were $6,000 and that profit for that month was $2,000. Thus, in charging a proportionate amount of costs out to a proportionate amount of sales, the profit incurred on repair sales for the month can be determined.

At this point, it is apparent that the profit percent or the ratio of profit to sales would be the same each month. This is true only if we are repairing one type of device. However, this is not apt to be the case. In most companies several different devices are repaired at the same time. The profit rate, unless all devices have the same mark-up, will vary with the mix.

When Inventory Is Taken

As in all systems, there are certain disadvantages and this system is no exception. A major hurdle is the difficulty in knowing when the labor content of the standard, derived from actual as previously described, has changed. The standard was set under the assumption that the efficiency of the department would remain

constant throughout the year. If the efficiency varies, the work in process will be overstated or understated. This can result in a substantial adjustment to work-in-process inventory at physical inventory time. A substantial adjustment to work-in-process inventory also means a substantial adjustment to the repair profit at inventory time. The complete check on the modified standard cost system outlined will be the physical inventory. Here is the key to the whole system:

1. Damaged device inventory will be given no inventory value. Therefore, it is not necessary to count or to keep a record of damaged devices.
2. The work-in-process physical inventory will be taken at one-half the standard cost. This is done by counting all the devices that are in various stages of repair. Of 3,000 devices under repair, about half are being torn down and half are being built up. By valuing 3,000 devices at one-half the standard cost (or $1), we have a $3,000 work-in-process inventory.
3. The repaired inventory will be costed at the full standard cost of $2 per device.

In comparing the book inventory to the physical inventory, it will be noted whether the efficiency of operating the repair department increased during the year. If so, there will be a larger physical work-in-process inventory than the book inventory shows. By taking the amount of the difference and relating it in percent to the total additions to work in process for the year, we can determine the amount that the modified standards are off. Before starting the next period, the standards can be adjusted to reflect current efficiency. This is illustrated in the examples shown below:

Physical work-in-process inventory priced at standard	$200,000
Book work-in-process inventory at standard	$175,000
Standard inventory overage	$ 25,000

Total standard additions to work-in-process for the year equaled $500.000.

$$\frac{\text{Standard inventory overage}}{\text{Total standard additions}} = \frac{\$\ 25{,}000}{500{,}000} = 5\%$$

Before beginning the next fiscal period all standards would be lowered 5 per cent.

A Quick Look over the Shoulder

Review now the system we have established and see whether the goals have been reached. The first goal was to allow profits to be proportionate to the sales for the month. This has been accomplished by charging off costs of repairing devices on a per-device basis. The second goal was a book inventory figure to indicate an increase or decrease in work-in-process. This also has been accomplished by taking total costs incurred in the month, and determining from them the number of devices that should have been repaired. If this number of devices has not been taken from the work-in-process inventory and put into repaired device inventory, we know that the work-in-process has increased or decreased. The last goal was to get actual cost figures on each type of device. And this can be done by making cost studies of short runs. In other words, a short term job cost approach will yield actual cost figures that can double as standard costs.

There are disadvantages to the foregoing system, certainly. It does, though, fulfill some basic requirements. It indicates inventory valuation, it provides profit rates, despite fluctuations in product mix and seasonal sales, and—quite important—it involves only a moderate cost. The accountant can report back to the company manager with the system he has developed. Although it lacks much in the way of accounting razor-edge separation of different costs, it will give the manager a pretty fair idea of whether he is making or losing money on repairs.

The modified standard cost system is a step ahead of what is needed for the repair department centered around a single factory bench. Conversely, it is still some way from the accounting systems used for new production. The most realistic view is probably one that sees it as a means for handling an accounting "maverick" with acceptable results and costs.

Scientific Sampling Applied to Audit Testing of Inventories

by RUSSELL TAUSSIG

THE REPLACEMENT of judgment samples, involving risks of unknown degree, with probability samples, confidence limits of which can be quantitatively measured, represents an application of scientific method to auditing. This might well be called an operations research perspective to audit testing. One of the most important sampling areas in an audit today is that of inventories. It is the purpose of this article to describe how probability sampling was applied experimentally to the verification of inventories as part of the annual examination of financial condition of a co-operative.

Dual Nature of Audit Objectives

Before examining the factors relating to the selection of the sample design employed in this case, it is desirable to examine the relationship between the cost and the accuracy of the information to be obtained. This requires consideration of the purposes of the inventory verification. There are two separate audit objectives:

Minor—To determine an appropriate sampling plan for accepting or rejecting a given hypothesis concerning the number of defectives (discrepancies; see also definition below) in the inventory.

Major—To estimate total dollar value of the inventory within stated confidence limits based on a stipulated probability.

These two objectives are interrelated; however, it appears useful to distinguish between them because the sample design to be selected will depend on the relative importance of two objectives. The major objective requires the estimation of the total of a random variable of a population based on a sample and the determination of the precision of that estimate. This total becomes a material factor in the expression of the auditor's opinion. Saul Levy in his book *Accountants' Legal Responsibility* has outlined the liability of the auditor

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under the headings of (1) liability to clients, (2) liability to surety companies, and (3) liability to third parties.[1]

It is the liability to third parties, that is, parties other than clients that has given rise to most of the court cases. It is this liability which sound sampling procedures should avoid when directed toward the first goal, that of determination of the total dollar value of the inventory within stated confidence limits.

Estimation of Defectives as Means of Internal Control Evaluation

In the audit of the cooperative, estimation of the fraction defectives (number of defectives in relationship to the total population out of which the sample was taken) is secondary to estimating total dollar value of the inventory; nonetheless, it is important. As the physician does not restrict his examination to one part of the anatomy, the auditor does not restrict his examination to one subsection of the balance sheet in appraising the overall condition of the financial statement. The frequency and kind of error as determined in connection with work on inventories gives some indication of the overall working of the system of internal control, and an idea of what reliance can be placed on it in determining the general effectiveness of the accounting system. Suppose the price of canned goods were found to be overstated. This would prompt an investigation of food vouchers, with the possible discovery that the food buyer was embezzling by processing duplicate invoices on case goods, then overstating the inventory to relieve charges to keep the food cost ratio in line. Shortages in the linen inventory might direct an investigation into the activities of the house manager with a view towards reducing pilferage of linen. A shortage in teaspoons might direct attention to the crockery control procedure in the steward's department. Assurance that the rate of discrepancy is in control is important as a diagnostic phase of the examination.

In other words, while discovery of fraud is not the major objective of the audit program, an effective review of the system of internal control will give the auditor some idea as to the possibilities of defalcation and will generally uncover continuing cases of fraud. One of the objectives of any audit is the search of the accounting records for any evidence of embezzlement. The auditor's liability to the client and surety company for embezzlement is stated by Ralph E. Kent in the September, 1958, *Journal of Accountancy*: "A great many clients carry fidelity insurance to protect them against employee dishonesty. When a surety company has paid a defalcation claim it succeeds, through subrogation,

[1] Saul Levy, *Accountants' Legal Responsibility*, American Institute of Certified Public Accountants, 1954.

to whatever rights the client may have had against the accountant for the failure of the accountant to discover the defalcation."[2] Acceptance sampling methods will give the C.P.A. some measure of the risk assumed in signing the audit report.

Acceptance Sampling Procedures Applicable in Estimating of the Fraction Defectives

A defective might be defined as any discrepancy in quantity, price or extension. For instance, if Potatoes, sweet-Taylor-size 24/3 counted 21 and priced at $5.90 were extended $132.90 instead of $123.90, the item would be tallied as an error. If the count were erroneously taken as 19 or 23, this too would be listed as one defective. Statistical sampling methods appropriate to the diagnosing the fraction defectives differ from those appropriate to estimating of the total inventory value.

A statistical decision rule might be established on the basis of a given hypothesis concerning the fraction defectives, where:

N = total number of items in inventory, called the population or lot.

n = number of items in sample.

P_0 = the worst quality at which the auditor is willing to accept almost all lots, called acceptable quality level (AQL).

P_1 = the best quality at which the auditor is willing to accept almost none of the lots.

H_0 = the hypothesis that the lot contains P_0 defective.

H_1 = the alternative hypothesis that the lot contains P_1 defective.

α = P [Acc H_1 / H_0 true], i.e., the probability of accepting H_1 when H_0 is true. This is a measure of the risk of rejecting good lots and doing more work on the inventory than required, called the "producer's risk."

β = P [Acc H_0/H_1 true], i.e., the probability of accepting H_0 when H_1 is true. This is a measure of risk of accepting bad lots, called the "consumer's risk."

c = the maximum number of defectives in a lot to be accepted.

The total number of items in the population $N = 1{,}200$ is given. The acceptable quality level $P_0 = 1\%$ is arbitrarily determined as the maximum fraction of defectives which can be accepted as being consistent with the adequate functioning of the system of internal control. Obviously, it should be a

[2] Ralph E. Kent, "Liability of Auditors", *The Journal of Accountancy*, September 1958, p. 62.

small number. The probability of considering the internal control system as being inoperative when, in fact, such is not the case $\alpha = 5\%$ is also determined arbitrarily. Insofar, as the consequence of going astray on this hypothesis simply means a slight bit more auditing time, the risk is not crucial and, accordingly, is allowed to go up to 5%. The risk of accepting bad lots, was set at $\beta = 1\%$. It should be a very small number. As was discussed above, the size of beta will depend on the consequences of accepting a bad lot, thinking it to be good. The cost of such an error depends mostly on the legal liabilities and related dangers in connection with fraud and misstated reports. A further arbitrary specification is made on the percentage defectives which may exist in the alternative hypothesis H_1, say $P_1 = 5\%$. Because of the way in which H_0 and H_1 were defined, it is apparent that H_1 is the really crucial hypothesis from the auditor's point of view. Whereas the cost of rejecting a sample by the decision rule only to find that the system was in control is not great, the cost of accepting the inventory as being in control when such was untrue might be a very costly proposition.

In summary:

$P_0 = .01$ $\qquad$ $\alpha = .01$

$P_1 = .05$ $\qquad$ $\beta = .01$

Required:

n and the acceptance number c

In *Statistical Sampling for Auditors and Accountants,* L. Vance suggests the possibility of determining n with the use of what is known as "Cameron's Table".[3] The reference cited presents paired values of α and β as a function of the acceptance number c and nP_0. A section of the table is reproduced in Exhibit 1.

A Section of "Cameron's Table"

P_1/P_0

c	$\alpha = .01$ $\beta = .10$	$\alpha = .01$ $\beta = .05$	$\alpha = .01$ $\beta = .01$	nPo
0		298.073		.010
1		31.933		.149
.....		.....		.....
4		7.156		.436
5		5.889		1.279
6		← 5.082 →		2.330

EXHIBIT 1

[3] Lawrence L. Vance and John Neter, *Statistical Sampling for Auditors and Accountants,* John Wiley & Sons, Inc., 1956, p. 93.

For the statistical decision rule at hand, the table is entered in the column headed $\alpha = .01$, $\beta = .05$. The ratio of P_1/P_0 is .05/.01 or 5. The closest value is \$5.082 which indicates an acceptance number of $c = 6$. The ratio of sample size times P_0 is

$$nP_0 = 2.330.$$

$$\text{Whence } n = \frac{2.330}{P_0} = \frac{2.330}{0.01} = 233$$

Application of Single-Sample Acceptance Plan

A sample of 233 items was taken from the population of 1,200 inventory items with the statistical decision rule of: if the selection results in no more than 6 errors, accept the hypothesis that the population contains 1% defectives; but if more than 6 errors are discovered, reject the hypothesis of 1% defectives and accept the hypothesis of 5% defectives. Examination of the inventory lists indicated that the items appeared to be arranged in a purely random order. There was no evidene that any type of serial order ran through the list. Thus a systematic sampling was used to draw the 233 items rather than random numbers which would have required a little bit more time. In effect, the sample obtained was a simple random sample. To achieve an arbitrary start, a die was cast, which came up trey. Starting with the third item in the inventory, every fifth item was checked until a sample of 233 items were compiled.

The data used for this experiment were the audit working papers of a prior year in which some 800 items out of the 1,200 had already been verified. For the purpose of this investigation, if an item was to be included in the inventory on which no information was available, it was passed and the next item in line was selected. Because of the way in which the original items were selected, it is believed that no serious distortion results in this study. There is no reason to believe that, in the original selection, the items omitted from checking contained any less or any more error than those included.

Six defectives were discovered in the sample of 233 items, so the lot would have been accepted as being within the limits of acceptable quality. Following this rule in a great number of audits would result in accepting an inventory as containing 1% defectives, whereas, in fact, it contained 5% defectives one time in a hundred. About one time in twenty an inventory would be rejected as having 5% defectives when, in fact, the true defective count of the population was much lower.

While the acceptance sampling applied in this case was a single sample plan, it might be desirable in some other situation to consider the use of a sequential

sampling plan. Under such a plan, an acceptance and a rejection number would have been determined after the first sample item had been selected, another set of such numbers after the second sample item, and so on until a definite decision on acceptance or rejection had been reached.

The Total-Dollar-Value Estimate

While the evaluation of internal control was a significant consideration, particularly with regard to inventories, it was, nevertheless, subordinate to the overriding necessity of expressing an opinion on whether there was evidence that the financial condition of the client was fairly stated on the basis of "such tests of the accounting records as were considered necessary under the circumstances."[4] The major inventory objective of the audit of the cooperative was to estimate the total dollar value of the inventory within stated confidence limits, based on a stipulated probability. The total might be estimated in several ways. One method would be to determine the mean value of the items in the sample and multiply by the number of cases in the population. As it turned out in this case, it was more efficient to estimate the aggregate by a *ratio estimate.*

Although sampling of inventories has been as ancient as the practice of auditing, until recently the amount of sampling has not been determined by anything except the auditor's professional "judgement". "We do not mean to imply that expert judgement is usually not good," states Hansen, Hurwitz and Madow, "but there are many situations in which it is important to know how far an estimate may be from the result of a carefully conducted complete count."[5] Test checking is an accepted auditing procedure. It is not a question, then, of whether to sample or not; rather it is a question of how much and what kind of sample. Hansen, Hurwitz, and Madow suggest a law which might be paraphrased to read: "Good samples tend to drive out bad."

How Much to Sample?

The problem of how much to sample may be stated as the determination of the size of the sample necessary to ensure a satisfactory degree of certainty that a sample estimate is in error by no more than a specified amount. The necessary size of sample is given by[6]

[4] Suggested short form audit report, American Institute of C.P.A., "Statements on Auditing Procedure".

[5] Morris H. Hansen, William N. Hurwitz, and William G. Madow, *"Sample Survey Methods and Theory"*, Volume I (New York: John Wiley & Sons, Inc., 1953), p. 6.

[6] *Ibid,* p. 127.

$$n = \frac{k^2 \; NV^2}{ND^2 + k^2 \; V^2} \qquad (1)$$

where N is the size of the population and it is desired that D, the relative difference between the estimated total from the sample and true total, be equal to some constant k times the coefficient of variation V.

In the present investigation, it was decided to put $k = 3$, so that $k^2 = 9$. This virtually assures that the difference between the estimated total from a sample and the true total will be no greater than D, which was taken as 4%. The question arises why D should be put equal to 4%? Why not 3% or 5%? By what method do we select one alternative over another? Fundamentally, it is a matter of the outcome which results from the action taken as a result of the sampling plan. If the opinion is expressed that the statement fairly presents the financial condition of an organization when it does not, the auditor may be subject to liability and/or disapprobation. While it might be possible to quantify the cost of error and translate the cost into a determinant of D, such a refinement did not appear to be warranted in the case of the current application, particularly in deciding on the size of the sample. Once the sample is taken, the precision of the sample can be computed and, if not adequate, then the sample size can easily be enlarged. The last variable in the formula to be discussed is the familiar Pearson coefficient of variation, V. This measure of relative dispersion was estimated from a sample of 100 items taken from the working papers of the prior year. Using the estimate of V in (1) results in an n greater than 100, which indicates that V, itself, was computed from a somewhat small sample. However, any error in V should have little effect on the determination of n.

Ratio Estimate Method

Inspired by the results obtained by C. West Churchman in the sampling of interline charges with The Chesapeake and Ohio Railroad,[7] it was decided to experiment with the use of ratio estimates for the purpose of evaluating the probable dollar shortage in the inventory and the most reasonable estimate of its aggregate value. Unfortunately, it was observed that the problems faced in the inventory problem were not precisely the same as those faced in sampling for interline charges. In the railway case, each unit of the population had two observable characteristics such as revenue and the company's portion. In the

[7] *Railway Age*, "Can Scientific Sampling Techniques Be Used in Railroad Accounting?" June, 1952, p. 62.

case of the cooperative's inventory there were two characteristics for each item in a sense, that is, extended value and error. However, the error was nonexistent in the great majority of the items. Of course, it is possible to consider that each item has an error which, in a good number of cases, is zero. A scatter chart between error and value of inventory item shows a very close relationship between the two variables describable by a straight line through the origin, with an even greater concentration of points on the abscissa. Despite this obvious limitation on the use of the ratio method, it was considered sufficiently promising with reference to improved efficiency to be applied on an experimental basis in this study. As stated by Vance.[8]

> ". . . . it would appear that ratio estimates should be useful for auditing work. Experimentation by auditors will provide a more definite answer about the efficiency of ratio estimates in specific phases of the auditing work."

Furthermore, in a very similar case reported in "Sampling Techniques in Accounting" by Richard M. Cyert ratio estimates were used.[9] The study reported by Cyert was for the parts inventory of a manufacturer, made up of 5,600 items. The inventory was divided into low-value and high-value items. A complete verification was made on the high-value items, while the low-value items were sampled. For each item observed in the sample, a record was made of the value of the item on the company records and the difference, if any, as determined by audit. The aggregate of differences, divided by the total value of the sampled items, resulted in a loss ratio which, when applied to the book inventory, produced an estimate of the true inventory total.

It is suggested in Hansen, Hurwitz and Madow[10] that the ratio estimate method will generally be found useful for estimating totals when there is some correlation between the numerator and denominator. In the given case, a plotting of the dollar amount of the errors against the totals indicated a very high degree of such correlation. Dollar errors were much larger in the high-value items that in the low. It is also pointed out that whether a ratio estimate will mprove accuracy for a given sample size over a simple unbiased estimate depends upon the variability in the numerator as compared with that in the denominator.

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[8] Vance and Neter, *op. cit.*, p. 202.

[9] Robert H. Trueblood and Richard M. Cyert, *"Sampling Techniques in Accounting"*, (New York: Prentice-Hall, Inc., 1957) p. 85.

[10] Hansen, *et al, op. cit.*, p. 166.

Sampling Techniques Applied

Having decided on a ratio estimate for the inventory survey, the next decision was whether to draw the items from the population by a table of random numbers or by systematic selection. In the present investigation, it appeared that some time might be saved by merely continuing to draw every fifth item from the original inventory working paper list. The 233 items, selected as previously discussed, were increased by 132 to produce the sample of $n = 365$.

The inventory contained 14 items the extension of which amounted to over $150; the remaining 1,186 formed the population for the ratio estimate. (Incidentally, each of the 14 large-valued items was checked and found to be without error.) For the sample of $n = 365$, the value of each item Y_i was listed as well as the dollar shortage X_i. The statistical sampling technique was applied to a year in which the error in the inventory was far above normal, due to a change of accountants and for a number of other reasons. Insofar as there were only three overages in the inventory and all the rest were shortages, the sign of X_i was taken as plus for a shortage, to facilitate computation.

$$n = 365$$

The sum of the shortages $\Sigma x_1 = x = 853.01$, while $y = 13{,}326.15$. So the ratio

$$r = \frac{x}{y} = 6.4\%$$

Applying this ratio of error to the book inventory of $44,148.00 results in a reduction of $2,825.47, producing an adjusted total of $41,322.53.

Evaluation of the Results

Having estimated the total value of the inventory, it was considered desirable to evaluate the precision of the results obtained. The variance of the ratio estimate is given by[11]

$$S_r^2 = (1 - f)r^2 \frac{(V_x^2 + V_y^2 - P^1 V_x V_y)}{n}, \qquad (2)$$

which simplifies to

$$S_r^2 = (1\text{-}f) \frac{\sum^{n} (x_1 - r\, y_1)^2}{(n-1)\, n\, \bar{y}^2} \qquad (3)$$

where f = fraction of population sampled
x_1 = shortage for any item
r = shortage ratio
y_1 = book value of any item
n = number of items in inventory
$\bar{y}$ = mean value of y.

[11] *Ibid.*, p. 176.

Computations appear in Exhibit 2

RATIO ESTIMATE COMPUTATIONS

(1) y	(2) nu	(3) x	(4) $x-nu$	(5) $(x-nu)^2$
26.25	1.68	2.36	.68	.46
48.84	3.12		3.12	9.74
49.14	3.14		3.14	9.86
58.20	3.73		3.73	13.91
12.50	.80		.80	.64
57.40	3.67		3.67	13.47
15.60	1.00	14.04	13.04	169.00
23.60	1.51		1.51	2.28
33.75	2.16		2.16	4.66
7.50	.42		.42	.17
9.75	.62	8.77	8.15	66.42
30.00	1.92		1.92	3.69
4.35	.24		.24	.06
82.50	5.28		5.28	27.88
18.20	5.65	−11.39	17.04	289.04
TOTALS 13,326.15		853.01		14873.75

$n = 365$ $\quad \bar{X} = 853.01$ $\quad Y = 13,326.15$ $\quad u = \frac{\bar{X}}{\bar{Y}} = .06401$

$f = n/N = 365/1,186 = .308$ $\quad 1 - f = .692$

$\sum^{365} (x_i - u y_i)^2 = 14,873.75$ $\quad \bar{Y} = 36.51$ $\quad \bar{Y}^2 = 1,332.98$

$$S_N^2 = (1-f)\frac{\sum^{n} (x_i - u y_i)^2}{(n-1)\, n\, \bar{Y}^2} = .692 \frac{14,873.75}{(364)(365)(1,332.98)} = .000058$$

$S_N = .0076$

$3S_N = .0228$

EXHIBIT 2

It can be concluded that if samples of 365 items were to be drawn a sufficiently large number of times, there would be very little likelihood that the error ratio would exceed $3S_r = 3(.0076) = .0228$. Applying plus and minus .0288 to the estimated inventory total of $41,322.53 results in an amount of $942.15. It may be stated with great confidence that, if all of the inventory items had been examined, the total obtained would be between $40,380.38 and $42,264.68.

Stratification of Inventory Samples

A type of stratification was used in the sampling of the co-operative's inventory in that each of the fourteen inventory items of value greater than $150 was verified. There did not appear to be any advantage to further stratification of this particular inventory sample. However, it has been generally accepted auditing procedure to use a stratified sample in inventory testing. Field audit instructions might read: test all extensions over $1,000, 80% of those between $500 and $1,000, 50% of those between $100 and $500, and 10% of the remainder. On an engagement involving more items and with a different kind of distribution than the co-operative audit, such a stratification would add to efficiency. Hansen, Hurwitz and Madow[12] indicate that:

> "It will be found that, unless exceedingly large differences are accomplished between strata and only small amounts of variation remain with the strata, the gains will be only moderate or perhaps barely noticeable," and, in fact, ". . . sometimes a loss can actually be taken by using stratification with proportionate sampling."

If the inventory items could have been grouped into strata such that the differences between stratum means were large, with relatively little dispersion within the stratum, then the problem would be to determine the optimum allocation of the population into strata. Assuming equal costs per unit for each stratum this could be effected by:

$$\text{opt. } n_h = \frac{N_h S_h}{\Sigma N_h S_h} n \qquad (4)$$

$$\text{where } S_h = S^2_{hx} + R^2 S^2_{hy} - 2R_{Phxy} S_{hx} S_h Y \qquad (5)$$

in which the subscript h refers to the stratum.

It is evident that increases in statistical efficiency are obtainable only at an increase in cost of sample design and somewhat more complex equations for measuring variance. It would take an audit of major proportions to make stratification pay off from the viewpoint of increased efficiency translated into time saved.

A Quantitative Measure of Errors Is Obtained

The main advantage accruing from an operations research approach to the sampling problem is the quantification of a prior subjective opinion. Whereas the only justification in the past for a given sample size was "professional

[12] *Ibid.*, p. 201.

judgment", scientific methods enable the quoting of odds on stated confidence limits bounding the estimated inventory value. General statements in the long form audit report such as "the inventory was tested to the extent we considered necessary under the circumstances" may now be replaced by the more exact statement: "the best estimate of the inventory value is $40,322.53 and we are 99.74% confident that the limits of $40,380.38 and $42,464.68 contain the true value." Without such a probability statement, the credit grantor, investor and every member of the business community knows that the balance sheet values are inexact, but he is without a measure of the magnitude or risk of error. Operations research methods supply a quantitative measure of the magnitude and risk.

Another conclusion results from the inventory study, namely, different audit objectives require different sample designs. Early application of probabilistic methods to auditing were in the form of acceptance sampling. The writer concludes from the present investigation that, while such techniques are useful, they resolve only one audit objective, and that one is minor. Every inventory is subject to a certain number of human errors. Inventory to inventory will vary as to percentage error due to "chance causes". Variation within some stable pattern is inevitable. The possibility of discovering variation outside of this stable pattern immediately suggests the methods of quality control and acceptance sampling as discussed in this article. For larger engagements, the acceptance methods might be of the sequential type as developed by Wald. In these acceptance methods, the point of view is one of attempting to determine whether the system is in control. This is useful in judging whether the accounting system can be relied upon and whether it gives evidence that the possibilities of fraud are negligible. However, the chief objective of an audit is not to discover fraud, rather it is to gather sufficient evidence so that an opinion may be expressed on the fairness of the financial statements. This suggests more the use of survey rather than acceptance sampling methods.

Potentials in Internal Control Procedures

Investigation into the use of scientific sampling methods in the audit of the co-operative's inventory suggests that even more powerful applications lie in the day-to-day internal auditing rather than the annual examination of financial condition by independent auditors. It would be very possible to take a physical count of part of the inventory each month. The establishment of quality control procedures would enable the internal audit staff to determine how large a percentage error could be tolerated on any such count and yet be able to con-

tinue with the hypothesis that the inventory is under control. If acceptance sampling were used in such a case, there is no reason why some type of acceptance sampling procedure based on the degree of error such as the Military Standards Tables 105A (with standards of normal, strict, and loose) might not be applied. A further related application of statistical methods is in daily food costing. Each day the food manager is supplied with the cost per serving of each meal. This involves a considerable amount of clerical work in charging each onion and radish to the daily food sheet. It is entirely possible that, if a weekly sampling were made to determine the same cost, the information supplied would be improved due to the lessened clerical fatigue.

Adoption in Auditing Procedures Recommended

Having applied scientific sampling procedures and found it useful in this experimental situation, a question arises as to its eventual unaminous adoption by the profession as a generally accepted auditing procedure. Operations research may appear a trifle esoteric to the conservative auditor, who is apt to rely on no stronger justification for procedure than the "Grandfather" policy. However, the well-educated business community of today is more inclined to put faith in the quality of auditing work as demonstrated by the scientific methods of the firm, rather than the venerable name of some long dead Scotsman in the style name.

At a recent meeting the question was raised of what a firm would do if it had written up an acceptance sampling plan in its working papers showing a maximum of, say, seven defective receivables; and minutes before delivery of the audit report to the board of directors, an eighth exception appeared. The report is printed and ready for delivery. The board will act upon it to declare dividends, to authorize plant expansion and to sign an indenture for a new bond issue. In the good old days, the report could be delivered to the board of directors by the certified public accountants without any fear of criticism. If there were some discrepancy and the auditors were sued, they could always testify under oath that they tested the receivables to the extent they considered necessary under the circumstances, based on their professional judgment. But with acceptance sampling, the auditor's very own working papers contain sufficient evidence to prove his negligence.

Paradoxically, the danger of working paper self-incrimination is the most powerful argument in favor of scientific sampling. Without a probability sample, the audit report would be delivered to the board incomplete, inaccurate and conveying an erroneous impression of exactness. Delivering such an audit

report gives the same false sense of assurance that a man might get driving down the freeway one hundred miles an hour in a blinding fog. As he wildly flies along he does not see the peril of obstacles and oncoming cars. Not seeing the danger in no way removes it. Clearing away the fog reveals the risk. Scientific sampling clears away the fog and clearly reveals the risk involved in expressing an opinion on the financial statements. As stated by R. Clay Sprowls:

> "Since the modern theory of statistical sampling has its foundations in the theory of probability, it permits a measurement of the magnitude of the possible error in the sample result and a definite probability statement about the uncertainty of inference."[13]

This is the advantage of an operations research perspective to the testing of inventories as investigated in connection with the audit described in this paper.

[13] R. Clay Sprowls, "The Admissibility of Sample Data to a Court of Law: A Case History", *U. C. L. A. Law Review*, February 1957, p. 224.

A Pilgrim's Progress Toward E.D.P.

by DONALD A. REED

LYING BEFORE US is a splendid city called Electronic Data Processing. In this shining city dwell Electronic Computer, Magnetic Tape, Transistor, Automatic Programming, and a host of other illustrious, efficient citizens. The inhabitants of E. D. P. are perfectly integrated since they follow a noble leader, Common Language. All the undesirables—Transposition, Clerical Error, Paperwork—have been banished to the faraway realm called Elimination of Duplication. The single entrance to the City of E. D. P. is through the Gate of Original Document and the only exit is over the Bridge of Final Report. Although we have not reached this city, we do not doubt that it exists because, by a kind of faith, we see it clearly.

We see less clearly the path that leads to the city and the obstacles that we shall meet along the way. The time required for our journey we do not know but, at least, we have started.

Convictions, but Sound Judgment Also

Our conception of the excellent City of E. D. P. comes from two sources: the computer manufacturers' stories of what can be and our own conviction which has grown as we have learned the ways of electronic data processing; the knowledge of our road comes only as we travel along it. Like John Bunyan's pilgrim, Christian, on his way to the Celestial City, perhaps we should pause a moment to reflect on a few of the experiences that one may encounter along the way.

Very likely, an organization will take its first overt step by having several of its people investigate whether the organization can use a computer to advantage. These persons will shortly become very familiar with electronic data processing methods. After a time, they will probably develop the conviction that a computer would have profitable applications in broad and new areas within the organization. They will not be able to prove their conviction at first. For them no proof is needed. They will have reached an intuitive conclusion.

However, those who must finally decide whether or not a computer is to be installed will hardly accept someone's intuition as the basis for a decision.

DONALD A. REED, Lancaster Chapter, 1951, is a Procedures Accountant for the Armstrong Cork Company, Lancaster, Pennsylvania. He joined Armstrong in 1951 upon graduating from Drexel Institute of Technology in Philadelphia. For the past three years, Mr. Reed has helped to develop applications for I.B.M. 650 computer.

Unless the organization has a big job that makes the use of a computer obvious even to the uninitiated, the group that makes the investigation must translate its conviction into a rational statement of opinion, and must find applications that will demonstrate the soundness of this opinion. Its statement must give specific answers to questions like these:

What jobs should we put on the computer?

What kind of a computer should we get?

Will the computer pay for itself?

Where will we put the computer? Who will be responsible for its operation?

What peripheral equipment will we need to use with the computer? How much will the one-time installation costs be for such things as setting up air conditioning and humidity-control equipment, meeting power requirements, readying space for the computer area?

What effect will the computer have on our personnel?

Can we train our own people to program and operate a computer successfully?

What effect will the computer have on our organizational structure?

Will the computer enable us to do significant work that we could not do without it?

Will the know-how we would acquire warrant our installing a computer now, even though it may not pay its way initially?

Should we regard the investment in a computer as a venture in research and not try to measure it with a dollars-and-cents yardstick as we would measure another piece of equipment?

Should we undertake an organization-wide systems study and attempt to automate on the grand scale?

Most of the questions having to do with computers fall into one of four broad groups:

1. What computers can do.
2. Philosophy of computers.
3. Effects on organization and personnel.
4. Costs.

Pioneering the Company's Way to E.D.P.

The first work in a computer investigation is to accumulate facts in the field and to try to understand them. Every organization must pioneer its own way to the City of E. D. P. It cannot travel another's path. Consequently, after the persons charged with the investigation have assimilated their facts, they must develop the organization's computer philosophy. The development of such a

philosophy represents an important fork in the road to E.D.P., because the way in which an organization looks at a computer will largely determine the importance it will give to questions about costs and the kinds of jobs to be put on the computer. In deciding which fork of the road to follow, a number of random thoughts come to mind:

1. If the computer must pass the dollar test like any other new equipment, the initial programming effort will not likely be turned to original work that has some risk, along with great promise; rather, jobs that are already being done, probably on punched card machines, will be moved on to the computer. However, if the organization has kept pace with advances in machine accounting developments through the years, finding savings in the transfer of punched card applications may be very difficult.

2. Learning to live with a computer can be an exacting task that requires a period of concentrated attention. To undertake an organizational study while installing a computer may be not only a premature step but also an unwise division of effort. An organization should assess a computer in terms of its own experience. It should acquire the kind of understanding that comes from living with one of the things, from working out some of its own applications and from having its own people use the results. Such an intimate working knowledge of a computer should be a requisite for any study of the impact of electronic data processing on the organization.

3. The first computer applications must not fail. However well the personnel in an organization are prepared for a computer, there will be some latent skepticism and hesitance to accept it. An initial failure may establish an abiding prejudice against any electronic data processing program.

4. One of the functions of the group which brings a computer into the organization is to stimulate creative staff and operating people to think how the computer can be used to do the work that could not be done otherwise. The members of the organization will probably understand the principles of a computer more easily when explained with a procedure familiar to them.

5. A danger in simply having a computer take over jobs that are already being done by other means is that people may overlook the unique features of the computer. When all of the originally-scheduled jobs have been transferred to the computer, a second danger is that the organization, to use a figure, may set up camp beside the road and fail to press on to the excellent City of E. D. P.

Speed Is Not the Only Point

When one thinks of electronic data processing and computers, one thinks of speed. The title of a book about an early computer was *Faster, Faster.*[1] The British periodical, *Engineering,* reported recently that an electronic teleprinting device which has a theoretical top speed of 500,000 words per minute is being produced by Burroughs Adding Machine Limited.[2] Its practical speed of 3,000 words per minute is set by the rate at which paper can be passed through the machine. Even so, it operates about twenty times faster than most people can talk. Information like this, with the touch of glamour, forms the popular image of E. D. P. Unfortunately, speed is not all in electronic data processing. Perhaps we can recognize at work here the "law" which Emerson wrote about in his essay, *Compensation:*

> "An inevitable dualism bisects nature, so that each thing
> is a half, and suggests another thing to make it whole; . . .
> If the good is there, so is the evil; if the affinity, so
> the repulsion; if the force, so the limitation." [3]

We might add: "If the speed, so the slowness."

Many Pitfalls Along the Road

When installing a non-computer procedure, the systems man can rely on the ingenuity and judgment of human beings operating the procedure to recognize exceptions and deal with them, to see errors and correct them, to meet new situations and improvise to handle them. In a sense, bridges can be crossed when you come to them.

When a computer is used in the procedure, bridges must be crossed before you come to them. Once the program is set, the human being is gone, and computers cannot improvise . . . yet. This means that all deviations from the main trend of the procedure must be anticipated and provided for ahead of time. Conditions of error must be controlled in the program through error routines. When a new situation arises, the old program must be revised or a new program must be written or the situation must be handled specially, outside the computer. Instructions to the computer must be written in its language with a preciseness that leaves nothing unconsidered. In block diagramming exercises in programming school, the student learns the first day that every loop must

[1] W. J. Eckert and Rebecca Jones, *Faster, Faster,* McGraw-Hill Book Co., New York, 1955.

[2] "Words, Words, Words," *Engineering,* January 2, 1959, p. 5.

[3] Ralph Waldo Emerson, "Compensation," *The Complete Essays and Other Writings of Ralph Waldo Emerson,* The Modern Library, New York, 1950, pp. 172, 175.

be closed because an open loop is an error. Thus scrupulous exactness in tying every loose end can take time—"gobs" of time.

A danger in this area is that those persons in the organization who pass upon installing a computer may not be adequately prepared for the long length of time that may be needed to get a computer into operation. If this time element is not appreciated as a normal part of the planning for a computer, the consequence will likely be impatience, if not disillusionment, with E. D. P. or, worse still, a suspicion of the abilities of those charged with getting the computer functioning. Many of the tragedies along the road to the City of E. D. P. come from traveling 100 m.p.h. when the conditions call for 35 m.p.h.

A. D. P., E. D. P., I. D. P. and T. D. P. are all part of the confusing jargon of data processing. Perhaps the term that most nearly expresses the ultimate in data processing is J. E. Johnson's description of T. D. P.—Total Data Processing—as "using 'electronic brain' systems to their maximum capabilities so it would be possible to eliminate all but the original piece of paper, and transmit electronically the intermediate reports." [4] When this accomplishment has become commonplace, we will indeed have reached the City of E. D. P.

Start Cautiously but Keep Moving On

Until that happy time, perhaps we can best measure our progress toward the City by looking at one of the recent surveys on computer applications. The Systems and Procedures Association has published a *Computer Use Report,* giving the results of a questionnaire on E. D. P. feasibility, that was distributed to its members.[5] From one of the tabulations in the report, we have listed in the following table the five most frequent applications in service and the five most frequent applications being programmed.

Five most frequent applications in service (82 firms reporting)		*Five most frequent applications being programmed (85 firms reporting)*	
Payroll	53	Payroll	37
Sales analysis	28	Sales analysis	26
Cost accounting	24	Raw material and stores inventory	23
Raw material and stores inventory	18	Cost accounting	20
Billing	18	Finished stock inventory	20

These applications, all of them ordinary and many of them certainly mechanized before the time of the "brains", are jobs that an organization uses in

[4] J. E. Johnson, "Total Data Processing May Number Days of the Punched Card as a Business Document," *Gas Age,* March 6, 1958, p. 31.

[5] *Computer Use Report,* Systems and Procedures Association, 1958.

learning to know a computer. They are transitional jobs that form a sort of link between the old way of doing things and a new way of organizing and doing what we are convinced, but cannot prove, lies ahead of us. Their significance is that, for many organizations, the computer becomes no longer a stranger. Its measure has been taken. The interest which had been intensely concerned with "How can we do this job?" is turning to the question, "What can we do that is beyond the ordinary?"

One approach that has been successful is to hold classes in certain programming techniques—techniques like the FOR TRANSIT Automatic Coding System [6] and the Bell Floating-Decimal Interpretive System.[7] After a short period of training and with no knowledge of the computer or of basic computer language, an individual can write computer programs in the particular system. In addition, he learns what a computer is capable of doing. A class in a coding system proved worthwhile because one person, just one, "caught fire." The enthusiasm of an individual who got a glimpse of, may we say, the excellent City of E. D. P. was largely responsible for opening his department to E. D. P. methods.

In another approach, a division accountant wrote a memorandum to the sales manager of his division, asking him to make a list of information that would help him in his responsibility but which he was not getting. He was not to consider whether getting the information was possible, practical or profitable; rather, in essence, if he had a genie lamp to rub, what information would he wish for? Here the opportunity for making the sales manager's wishes come true lay with the E. D. P. applications group.

The missionary approach to E. D. P.—seeking to persuade, to learn, to teach, and looking for opportunities and moving in on them, keeping sensitive to the temper of the organization—does not seem compatible with the revolutionary aura often associated with E. D. P. Yet, through this approach, followed over a number of years in one organization, three computers have been installed profitably, acceptance and respect for computers have been established, and continual progress is being made in developing and extending E. D. P. methods.

Thus, for many of us, the first part of our journey is over. We have learned to know the computer and its ways. The pilgrim's road stretches out before us—to the mountains of Change and Challenge, to the valley of Impatience—but ultimately, we know, to the excellent City of E. D. P.

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[6] *FOR TRANSIT Automatic Coding System for the IBM 650,* I.B.M. Applied Programming Department, 1957.

[7] "A Complete Floating-Decimal Interpretive System for the I.B.M. 650 Magnetic Drum Calculator," by V. M. Wolontis of Bell Telephone Laboratories, Inc., *Technical Newsletter No. 11,* I.B.M. Applied Science Division, 1956.

The Milepost Approach to Control of Research and Development Projects

by HARRY J. KRAIG

INDUSTRY AND GOVERNMENT today are spending a combined total of more than $10 billion annually on research and development. A large proportion of this cost is relatively uncontrolled or ineffectively controlled. With all due respect for our scientists and engineers, and their remarkable talents, it must be admitted that the engineering project over-run is too frequently the rule rather than the exception.

What are the reasons for the over-run condition?—Poor estimating? Project scope changes? Inadequate supervision? Impossibility of prediction? Lack of coordination of effort? Or, is it a more popular reason such as, "the accounting department is late in processing data and furnishes too much of the wrong kind of information?" Whatever the reasons may be, we must recognize that each job over-run not approved by the customer is a direct deduction from profit and, even if approved, results in a decline of the profit rate.

Effective project control is not easily achieved. Direct measurement of engineering effort is not practical. Beyond that, the engineers themselves display a certain amount of antipathy against any attempt toward control of engineering efforts. On this point, it should be mentioned that the plan of control described here has not been designed merely to control engineering effort as such. Its prime intent is to furnish the engineer and other responsible people with adequate operating information. Moreover, it is intended to free the engineer from excessive record keeping so that he may devote his time to engineering problems. Engineers frequently start with an intangible idea and apply their talents to creation of a tangible result. To lay out a sound plan for this process requires a certain amount of discipline, decisiveness, and determination. Sufficient fortitude is not always available. Although the engineer has a plan in mind, it has been found difficult to get him to lay out and use the plan in an orderly step-by-step fashion.

"Control" has been defined as checking or regulating to keep within limits.

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For proper control then, each responsible person in the entire engineering project cycle must possess certain minimum information, on a timely basis, so that he may intelligently check or regulate within the scope of his responsibility. Some of the persons directly concerned with a project are:

1. The functional engineer.
2. The project engineer.
3. The estimator.
4. The chief engineer.
5. The contract administrator.
6. The customer liaison engineer.
7. The financial officer.

In order that each may receive the necessary information, a sound and orderly system is required for recording, processing and reporting of data. This *must* be preceded by an orderly system of planning and estimating. A workable control system which satisfies these requirements, and a series of forms which illustrate data-flow under such a system, from the original estimate to completion of a project, are set forth in the following pages. All data presented in the exhibits have been prepared for illustrative purposes only.

Engineering Department Organization

A typical engineering organization chart is shown on Exhibit 1. This is a functional type of organization. Within each department shown, there are many

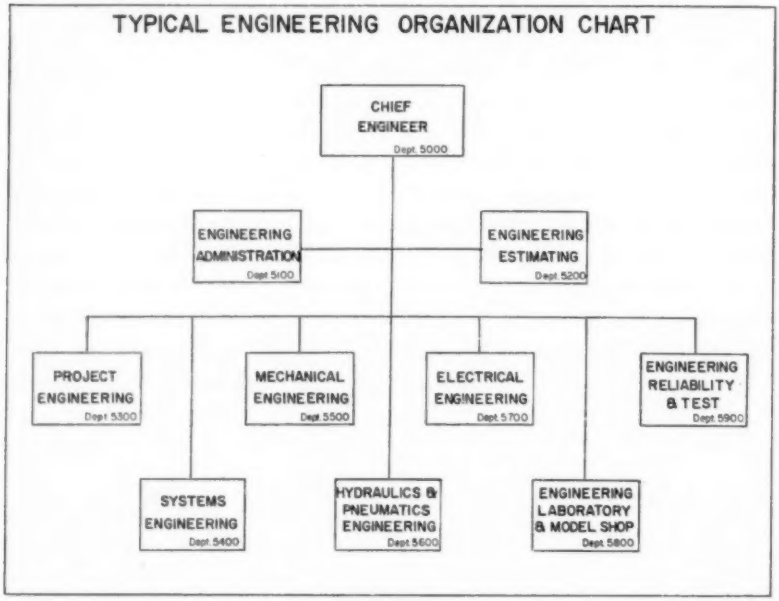


EXHIBIT 1

specific functional engineering groups. In large engineering divisions, the organization structure might first be arranged according to major products or product lines and then by functions within the product lines. Or, it may reflect a combination of a functional and product type organization. In either case, for our purposes, responsibilities at functional levels can be considered quite similar.

In the sample organization, the engineering administration department is responsible for the correlation and handling of engineering division costs data, engineering services, engineering preparation of proposals, etc. The engineering estimating department is responsible for coordination and completion of estimates, and for analysis and evaluation of estimating data. Frequently, this function is performed by the engineering administration department but it has been isolated here to high-light the importance of estimating. The project engineering department is responsible for project planning and surveillance. Each active project is assigned to a particular project engineer. He works across organization lines in his project control activities and is responsible for co-ordinating timely completion of the project within a budgeted amount of hours and dollars. Responsiblities of the remaining departments are evident from their titles.

For purposes of classification of data, all departments in the engineering division are assigned a single series of numbers. In the example, the 5,000 series identifies the engineering division. The second digit of the series identifies a particular department. The last two digits are reserved for identification of functional groups. It is possible that there may exist identical functional groups in more than one department. For example, design specifications groups might exist in the mechanical, hydraulic and electrical engineering departments. If such is the case, these groups should be assigned identical digits. In our sample organization they might be numbered 5507, 5607, and 5707, respectively. Some of this organizational coding will be employed in processing the sample project which is illustrated.

Comprehensible Project Planning and Estimating

Engineering projects may originate from within or without the organization. For the present purpose, we will consider a project originating with a potential customer. In the normal course of events, the engineering division's first tangible contact with a new project is in the form of a request for quotation or estimate. After reviewing the request, the project engineer may prepare an interpretation of the request, if necessary. When approved, the request is forwarded

to the estimating department. There, the request and interpretation are reviewed, and the estimate may be prepared in its entirety. In an alternate procedure, copies of the request may be forwarded to affected functional groups for time and material estimates covering their potential responsibilities within the entire project. Functional workloads may or may not be considered in delivery date promises. Respective group estimates are forwarded to the estimator where they are coordinated, summarized and routed to the engineering administration department for preparation of a proposal. Ultimately, the proposal is submitted to the customer.

If the proposal results in an order from the customer, the engineering department, and the company, may be in serious difficulty. The contributing reasons for this may be one, or a combination of all, of the following:

1. Inadequate consideration of project flow time.
2. Inadequate methods of project analysis and estimating.
3. Inadequate methods of cost accounting and reporting.

With respect to project flow time, delivery promises are made too frequently on the basis of pure engineering requirements and workload. Inadequate or overly optimistic evaluation is made of project or order flow time. Project changes, customer negotiations, partial approvals, coordination delays, etc., have an effect on the delivery schedule. The second and third reasons cited above define the essence of the control procedure outlined here. Initially, it is imperative that the project estimate be prepared in the same terms and along the same lines as the subsequent accumulation of costs. Also, the project analysis or plan must be comprehensible in terms of *tangible* results along the course of a project. To accomplish these goals, the original plan and the estimate must be designed to provide them.

Various attempts to define these interim goals have been observed and, also, a number of different methods have been found to be successful. Success in these cases was somewhat inversely proportional to the amount of pure research required. However, present in most successful situations was a practice of sectionalizing projects in terms of segments of an end item and, within it, by engineering functions. It is not enough to sectionalize a project by functions alone. Certain functions are of a continuing nature and overlap between segments of projects. With any volume of projects and work orders at hand, it can become incomprehensible to manage in terms of functions alone.

Project Outline in Terms of Mileposts

A workable procedure, even in pure research situations, is one employing what we might refer to as project mileposts. By definition for our purposes, a mile-

post is a segment of a project at which physical accomplishment can be indicated. Each milepost should lend itself to analysis by engineering functions and to estimating and scheduling in terms of labor hours and in terms of calendar time. A number of names have been given to the milepost concept, including "milestone," "gravestone," "phase," and "job block" which later evolved to "stumbling block." In spite of certain familiarity and affectionate system names, the concept itself has not been fully utilized in research and development project management.

Under the milepost concept of engineering job control, the project engineer is required to outline a project in terms of mileposts (as defined above). Sizes of mileposts will vary. However, as a general guide, mileposts might be established in project segments ranging from 500 to 1500 labor hours. Also, it should be noted that mileposts would not be defined for relatively small projects.

Our sample project requires the design of a "last word computer." The project engineer has defined five mileposts. They are:

01 Product specifications.
02 Mechanical layout.
03 Preliminary drawings and test procedures.
04 Prototype assembly and test.
05 Final drawings.

Estimates and Master Schedule

ELECTRICAL ENGINEERING - DEPARTMENT 5700
ESTIMATE SHEET

WORK ORDER NO. 70859 PAGE 1 OF X PAGES DATE April 18, 1959

PROJECT TITLE Last Word Computer TYPE Blue Sky

QUOTATION [X] ESTIMATE TO COMPL [ ] PROJ. ENGINEER R. Smith RESP. ENGINEER J. Doe

FUNCTION NO.	FUNCTION DESCRIPTION	MILEPOST (01) PRODUCT SPECIFICATIONS		(03) PRELIMINARY DRAWINGS		(04) PROTOTYPE ASSEMBLY			
		HOURS	MATERIAL DOLLARS	HOURS	MATERIAL DOLLARS	HOURS	MATERIAL DOLLARS	HOURS	MATERIAL DOLLARS
01	System Synthesis & Analysis	400							
07	Design Specifications	150							
10	Breadboarding	200							
13	Electrical Parts List			130					
21	Schematics			200					
30	Test Specifications			75					
32	Test Equipment Design					80			
33	Testing					150			
	TOTAL	750		405		230			

REMARKS _____

EXHIBIT 2

ENGINEERING ESTIMATE SUMMARY

DATE April 10, 1959
PROJECT TITLE Last Word Computer — TYPE Blue Sky
WORK ORDER NO. 70859 — DEL. DATE Dec. 31, 1959

MILEPOST NO.	MILEPOST DESCRIPT.	ENGINEERING DEPT.	ENGINEERING FUNCT.	ENGINEERING DESCRIPT.	HRS.	$
01	Product Specifications	5400	01	System Synthesis and Analysis	150	$ 2,250
			04	Preliminary Layout	100	1,500
		5700	01	System Synthesis and Analysis	400	6,000
			07	Design Specifications	150	2,250
			10	Breadboarding	200	3,000
	Total Labor				1,000	$15,000
02	Mechanical Layout					
04	Prototype Assembly	5800	03	Fabrication	350	$3500
			04	Mechanical Assembly	280	2800
			05	Electrical Wiring	190	1900
			33	Test	50	500
	Total Labor				870	$8,700
	Materials		90	Tooling		1,250
			91	Materials and Purchased Parts		800
	Total Material					$2,050
	Total Labor & Material					$10,750

TOT. DIR. COST: Labor $130,000, Material $7,000, Total $137,000

PROJ. ENGINEER R. Smith

EXHIBIT 3

EXHIBIT 4

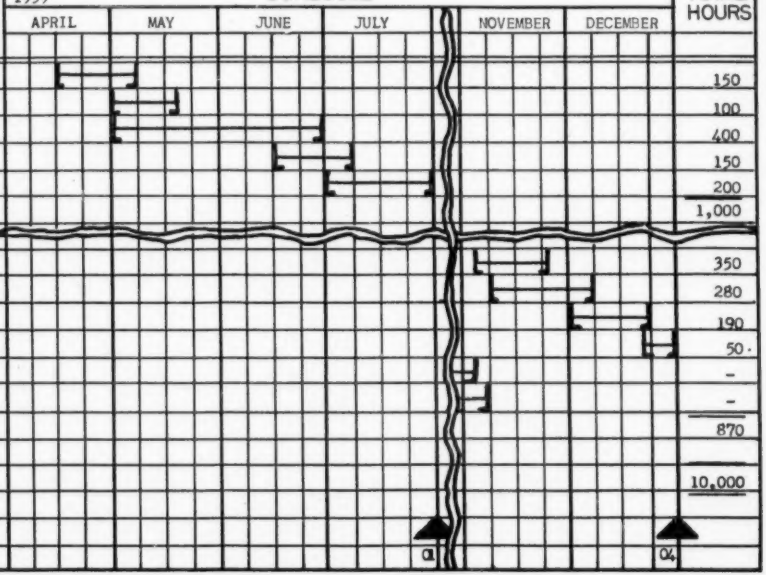
ENGINEERING PROJECT MASTER SCHEDULE

PROJECT TITLE Last Word Computer — TYPE Blue Sky — PAGE 1 OF 1 PAGES

WORK ORDER NO. 70859 — PROJ. ENGINEER R. Smith — DATE April 10, 1959 — TOT. HRS. 10,000

MILEPOST NO.	MILEPOST DESCRIPT.	ENGINEERING DEPT.	ENGINEERING FUNCT.	ENGINEERING DESCRIPT.	TOTAL HOURS
01	Product Specifications	5400	01	System Synthesis and Analysis	150
			04	Preliminary Layout	100
		5700	01	System Synthesis and Analysis	400
			07	Design Specifications	150
			10	Breadboarding	200
	Total Hours				1,000
04	Prototype Assembly	5800	03	Fabrication	350
			04	Mechanical Assembly	280
			05	Electrical Wiring	190
			33	Test	50
			90	Tooling	-
			91	Materials and Purchased Parts	-
	Total Hours				870
	Project Total Hours				10,000
	Delivery Schedule				

SCHEDULE — 1959: APRIL, MAY, JUNE, JULY, NOVEMBER, DECEMBER



The project outline is used by the functional engineering departments in their preparation of estimates. Each department summarizes its estimate on an estimate sheet as illustrated in Exhibit 2. It can be seen that this department has a functional responsibility in mileposts 01, 03 and 04. Also, the anticipated contribution of each functional group is readily apparent in the estimate. Estimate sheets from each department are summarized as shown in Exhibit 3. Labor and material estimates for each milepost are summarized, and the total estimated direct project cost is accumulated. Note that a number of engineering departments and different functional groups can contribute to a single milepost. Also, in this instance, functional codes in the 90 series are used to classify material costs.

With this basic data, functional workload and project flow information, the project engineer is in a position to prepare a master schedule as illustrated in Exhibit 4. The significant aspect of this schedule is the establishment of functional and milepost completion dates. Later, in project surveillance, it will be a routine matter to follow up on anticipated deliveries prior to completion of an entire project. Need for adjustment or corrective action, whether at the department level, management level or the customer level will be readily apparent as progress is recorded from one milepost to another.

Project Surveillance and Performance Reporting; Labor Reports

In our consideration of project surveillance we will be concerned primarily with engineering labor hours, as labor is the most significant cost factor in research and development projects. Control of burden or overhead is considered a separate matter and material costs normally are low in comparison. With respect to material costs, it has been found generally advisable to control these costs on the basis of commitments, which are recorded at the time of processing material or purchase requisitions. Application of routine practices in physical control of materials and material usage has been observed to be generally adequate for this cost factor.

Having completed a project plan and original estimate using the milepost concept, we have reason to face the receipt of an order with increased confidence in ability to perform. When a customer's order is received, an engineering work order usually is issued. In the recommended procedure, the engineering work order will outline the work to be performed according to mileposts, departments and functions. A milepost budget in terms of hours and material dollars also will be indicated for each function. Normally, this budget will be the same as the original estimate. Calendar due dates might be indicated on the work order or on a subsidiary schedule.

EXHIBIT 5

WEEKLY ENGINEERING LABOR REPORT - PROJECT ENGINEER

WEEK ENDING June 26, 1959

PROJECT ENGINEER	WORK ORDER	MILEPOST	DEPT. AND FUNCTION	EMPLOYEE NO.	HOURS EXPENDED THIS PERIOD	TOTAL HOURS EXPENDED TO DATE	BUDGET HOURS	BALANCE HOURS
R. Smith	70859	01	5401	1723		140		
	70859	01		1850		30		
	70859	01		Total		170	150	(20)
	70859	01	5404	1741		90	100	10
	70859	01	5701	1538	40	330		
	70859	01		1510	10	50		
	70859	01		Total	50	380	400	20
	70859	01	5707	1921	40	120	150	30
	70859	01	5710				200	200
	70859	01	Total		90	760	1000	240

WEEKLY ENGINEERING LABOR REPORT - DEPARTMENT AND FUNCTION

WEEK ENDING June 26, 1959

DEPARTMENT AND FUNCTION	WORK ORDER	MILEPOST	EMPLOYEE NO.	HOURS EXPENDED THIS PERIOD	TOTAL HOURS EXPENDED TO DATE	BUDGET HOURS	BALANCE HOURS	
5401	70859	01	1723		140			
5401	70859	01	1850		30			
5401	70859	01	Total		170	150	(20)	
5404	70859	01	1741		90	100	10	
5701	70859	01	1538	40	330			
5701	70859	01	1510	10	50			
5701	70859	01	Total	50	380	400	20	
5707	70859	01	1921	40	120	150	30	
5710	70859	01				200	200	

Notes:
1. ( ) Indicates overrun hours
2. This illustration is in the form of a tabulating machine report

As engineering effort is expended, a daily time distribution record is made showing the hours devoted by each engineer to each work order and, of course, each milepost. As in any time-recording system, it is important that time be reported accurately. Time reports may be completed by the engineers themselves or by a timekeeper or control clerk who is employed to perform the time recording function. Conditions will vary from one situation to another. However, it will generally be found advantageous for the engineer to record his own time distribution. In this respect, it is not uncommon to hear that, "we can't get the engineers to record their time accurately." This problem is over-rated. With proper organization, assignments, and identification of work, the engineer, himself, will be best suited to complete his time report. To have others do it, usually involves a certain amount of duplication and unnecessary effort.

The daily time reports are summarized weekly in the form shown in Exhibit 5. This is a weekly engineering labor report which reflects the hourly input to each work order and milepost by functional groups and employees. The hours accumulated to date, the budgeted hours and the balance of hours remaining in the budget also are indicated. Because of the organizational situation of project engineering, this report is prepared in two forms. One summarizes data for each project engineer, showing all work orders for which he is responsible. The other report summarizes the same information, according to departments and functional groups. The value of this report is that it permits responsible persons to review project time accumulations in comparisons to observed progress during the course of a month. Also, functional supervisors are provided with data which can permit them to anticipate jobs requiring attention. Depending on individual situations, it is sometimes more practicable to prepare this report on a bi-weekly basis.

Monthly Project Status Reports

As of the end of each month, each functional group is required to prepare an estimate of hours required to complete its effort on each milepost. Using the same basic data contributing to the weekly report, the estimate of hours required to complete each milepost, and the original estimate, a monthly project status report is prepared. Such a report is illustrated in Exhibit 6. In contrast to the types of project status reports usually encountered, this type of report has a built-in and readily apparent measure of accomplishment. Results to date, or hours of work completed in terms of the original estimate, is determined by subtracting the estimate of hours required to complete each milepost from the originally estimated hours. Then, by comparing the hours of work completed

EXHIBIT 6

MONTHLY ENGINEERING PROJECT STATUS REPORT - PROJECT ENGINEER

MONTH ENDING June 30, 1959

PROJECT ENGINEER	WORK ORDER	MILEPOST	DEPARTMENT AND FUNCTION	HOURS EXPENDED TO DATE	ESTIMATE OF HRS. REQ'D.TO COMPLETE	HOURS OF WORK COMPLETED (3)	PERCENT VARIANCE TO DATE (4)
R. Smith	70859	01	5401	170	-	150	(12)%
			5404	90	-	100	11
			5701	380	60	340	(11)
			5707	120	30	120	-
			5710		200		-
		01	Total	760		710	(07)

MONTHLY ENGINEERING PROJECT STATUS REPORT - DEPARTMENT AND FUNCTION

MONTH ENDING June 30, 1959

DEPARTMENT AND FUNCTION	WORK ORDER	MILEPOST	HOURS EXPENDED TO DATE	ESTIMATE OF HRS. REQ'D.TO COMPLETE	HOURS OF WORK COMPLETED (3)	PERCENT VARIANCE TO DATE (4)	
Tabulate same information as above, summarizing all work orders under each department. "Percent variance to date" column will indicate orders requiring attention. "Estimate of hours required to complete" will indicate the departmental work load according to functions.							

Notes:

1. ( ) Indicates negative variance.
2. This illustration is in the form of a tabulating machine report.
3. Hours of work completed is determined by subtracting hours required to complete from the original estimate. These hours are not to exceed the original estimate.
4. Percent variance to date = $100 \left(\frac{\text{Hours of work completed}}{\text{Total hours expended to date}} - 1 \right)$

to the accumulated hours charged to date, a realistic measure of accomplishment is obtained. The level of performance or level of accomplishment to date can be stated in a number of different ways. One of the most acceptable methods appears to be a statement in terms of percent variance in the actual hours reported as compared to the estimated hours. Other methods of status reporting will be discussed later.

The monthly project status report, like the weekly labor report, is prepared for each project engineer, and the same information is summarized for each engineering department and function. This form of job status reporting can permit true project management by exception. A fast review of the "percent variance" column will indicate specifically which milepost and which functional group requires attention. Also, with the same information being reported to project engineers and functional supervisors, untold numbers of engineers' follow-up hours can be saved.

Summary Reports of Variances

It was previously mentioned that the financial officer of the company is also concerned with engineering projects. For his purpose, it would not be advisable to receive detailed reports on a continuing basis. However, using the data in the project status report, summary reports of variances can be prepared for management, as illustrated in Exhibit 7. These might be prepared manually from tabulated reports or by means of summary punched cards. Regardless of the means of preparation, it is extremely useful for management to receive a monthly report of variances to date, according to major work orders, contracts, and project engineers. The same information should again be summarized, according to engineering departments and functional groups. In this fashion, management could be adequately informed of engineering progress on a continuing basis by means of a one or two-page report.

It might be mentioned that the "percent complete" column is optional for reporting purposes. However, with the data now available in punched card form, this information is obtainable and can be found to be quite useful. It is indicative of the degree of work order or contract completion which can have a bearing on variance interpretation. It also is indicative of the functional and total engineering workload in terms of original estimates. For example, in the sample report, 60,000 hours of work have been completed, which are equivalent to 50 percent of estimated hours. This means that there are 60,000 additional hours of work which have been scheduled and are outstanding.

EXHIBIT 7

ENGINEERING SUMMARY REPORT - MAJOR WORK ORDER

WORK ORDER OR CONTRACT	PROJECT ENGINEER	HOURS EXPENDED TO DATE	HOURS OF WORK COMPLETED	PERCENT COMPLETE	PERCENT VARIANCE TO DATE
70859	R. Smith	760	710	07%	(07)%
TOTAL		61,200	60,000	50%	(02)%

ENGINEERING SUMMARY REPORT - DEPARTMENTS AND FUNCTIONS

DEPARTMENT	FUNCTION	HOURS EXPENDED TO DATE	HOURS OF WORK COMPLETED	PERCENT COMPLETE	PERCENT VARIANCE TO DATE
5400	01	1800	2000	15%	11%
	04	1000	950	21	(05)
TOTAL		61,200	60,000	50%	(02)%

Notes:

1. All active work orders are summarized in these reports.

Comparison to Other Methods of Project Status Reporting

At this point, we might review other methods of project status reporting. Exhibit 8 presents project status data in a manner which offers direct comparison of three different methods of measurement. In the first method (Column 4), the report shows the actual hours spent over or under budgeted hours for the period. In the second method (Column 7), an anticipated percent variance is computed for the total project. The third method (Column 8) is the percent-variance-to-date method, previously described and recommended. The weakness in the first method is that only actual and budgeted hours are compared. They do not necessarily relate to engineering progress or to work which might have been accomplished in the time spent. The weakness in the second method is that variances to date are spread over the entire project. This presumes that hours lost to date are the only hours which will be lost in this project or that the remainder of work to be performed will be accomplished precisely in the same number of hours as originally estimated. This is a fallacious assumption. There is no basis for anticipating perfect accomplishment, particularly in light of variances to date and other project experience. The third method (Column 8) recognizes time lost or gained to date on work accomplished to date. It is a factual, realistic, and a very sensitive method of control reporting.

It is interesting to note that in our sample data for the first month Column 4 shows that 200 budgeted hours have not been consumed. This can lead a person to believe that certain gains might have been made, while the opposite is closer to the truth. It can be seen (Column 6) that 200 hours of work have been accomplished in 300 actual hours (Column 3). This is a relatively serious condition. It should be investigated and assistance provided as required. The variance percentage shown in Column 7 probably would not invite such assistance for months after the fact. On the other hand, the percentage in Column 8 would certainly command some attention to the benefit of all concerned. The data for the ninth month also are worthy of mention. It appears in Column 4 that the trend of lost hours has been reversed. However, this apparent correction is due only to an increased budget of 1500 hours for that month. Total budgeted hours tended to "catch up" with actual hours expended to date. The facts for this month are that 1100 hours of work were performed in 1250 actual hours. There was an actual "slippage" of 12 percent, which, as it turns out, is "average for the course" on this project.

Everyone Benefits

The milepost approach to project control is based on sectionalizing a large

EXHIBIT 8

COMPARATIVE PROJECT STATUS REPORT

(1) PERIOD	(2) HOURS BUDGETED TO DATE	(3) HOURS EXPENDED TO DATE	(4) HOURS (OVER) OR UNDER BUDGET	(5) HOURS REQUIRED TO COMPLETE	(6) HOURS OF WORK COMPLETED (3)	(7) ANTICIPATED % VARIANCE IN TOT.PROJ.(4)	(8) PERCENT VARIANCE TO DATE (5)
1st Month	500	300	200	9,800	200	(01)%	(33)%
2nd Month	2,000	2,000	-	8,500	1,500	(05)	(25)
3rd Month	3,000	3,100	(100)	7,300	2,700	(04)	(13)
4th Month	4,000	4,500	(500)	6,000	4,000	(05)	(11)
5th Month	5,000	5,400	(400)	5,500	4,500	(08)	(17)
6th Month	6,000	6,800	(800)	4,000	6,000	(07)	(12)
7th Month	6,500	7,300	(800)	3,500	6,500	(07)	(11)
8th Month	7,500	8,400	(900)	2,600	7,400	(09)	(12)
9th Month	9,000	9,650	(650)	1,500	8,500	(10)	(12)
10th Month	9,500	10,800	(1,300)	500	9,500	(12)	(12)
11th Month	10,000	11,400	(1,400)	-	10,000	(12)	(12)

Notes:

1. (*) Indicates negative variance.
2. For purposes of brevity only cumulative hour columns are shown.
3. Hours of work completed is determined by subtracting hours required to complete from the original estimate. These hours are not to exceed the original estimate.
4. Anticipated percent variance in total project $= 100\left(\frac{\text{Total project estimate}}{\text{Hours expended + Hours Required to Complete}} - 1\right)$
5. Percent variance to date $= 100\left(\frac{\text{Hours of work completed}}{\text{Hours expended to date}} - 1\right)$

incomprehensible mass into small controllable pieces. Little or no additional data handling or processing is introduced. Frequently, in fact, the total amount of related data handling is reduced by way of effective coding and processing useful information only. We are working with basic data already available (original estimate and estimate to complete) and with operations already being performed (labor distribution). We are coding and classifying our basic data in a manner which will produce operating control information as a by-product of the accounting system which funnels the same information into contract costs and operating statements.

The accountant is looked to, and rightfully so, as the source of accounting and statistical information for analysis and interpretation. The success of this plan of control is dependent upon the timely performance of the accounting function in compiling data and developing the measurement report for presentation to responsible persons. As a result, the engineer is permitted to concentrate on engineering problems. Key control information is summarized for him in a manner which high-lights areas of difficulty while they are in their infancy and not after they have turned into wildfires. He is advised of his progress as related to his own estimate on a specific project.

This plan of control has been designed to recognize the needs of others in addition to the engineer. It contains the ingredients for effective scheduling, and extremely valuable information can be accumulated for estimating purposes. Management is interested in and can determine trends of variances or changes from the estimate or the plan. It should be remembered that, from the standpoint of management, negative variances or excessive hours on one project may not be necessarily bad, when compared to the overall picture, but late reporting of the fact always is bad.

Eliminate Pennies — Save Dollars

by PAUL J. HORSCHLER

BRIEFLY, WHOLE-DOLLAR ACCOUNTING is a system which eliminates pennies, where practical, from preliminary records and books of account. This penny elimination is done in order to simplify posting, proving operations and subsequent reports and analysis made from the books and records. The pennies are eliminated by a process of rounding to whole-dollars with the penny variance cleared to a "penny account." Therefore, whole-dollar accounting is not merely the dropping of pennies from financial reports, statements and various analyses but a true accounting system. The whole-dollar system affects almost every balance sheet and profit and loss account in the company. The exceptions are those accounts involving "third parties", or "outsiders". These accounts, i.e., cash, accounts and notes receivable, accounts payable, tax accounts, etc., should be maintained in exact dollar-and-cents amounts.

Whole-dollar accounting has been known by other titles, all of which describe the same system. Here are a few you might recognize: pennyless accounting, centsless accounting, penny elimination accounting and controlled-tolerance accounting. The pioneer in whole-dollar accounting was Bethlehem Steel Corporation. Bethlehem's controller began work on the system in 1927 as a work-simplification measure. It made sense to him that pennies were of small importance in an over-all accounting operation which amounted to hundreds of millions of dollars. Not until the late 1940's and the early 1950's did many companies follow Bethlehem's lead. But since then an impressive number of companies has joined in the adoption of this system.

The great majority of companies have dropped pennies from financial statements, reports and analyses. Why has this been done? All of the reasons can be linked directly to cost reduction or increased productivity. Dollars-only statements take less space when pennies are dropped. Their format is improved, they are easier to read and their effectiveness increases. Executive, as well as management and supervisory personnel, find "dollars-only" more readable and easier to get at and comprehend the significant information recorded. Some companies even report in hundreds and thousands only. In many cases these changes were made at the request of executives, themselves. They realize that dropping cents results in less digits to digest. This increases the reader's pro-

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ductivity; he may read and digest more in less time. The same points that result in savings by dropping pennies from reports will be multiplied many times by whole-dollar accounting.

Fewer Digits

A recent survey reported that, among certain companies tested, the numbers most commonly entered or posted in their accounting operations consisted of five digits plus the decimal point. Whole-dollar accounting can, by eliminating the pennies and decimal point, result in a theoretical reduction of physical work of 40 percent. The net reduction will be somewhat less because of the rounding and posting to a penny-elimination account; however, in all subsequent postings the work reduction multiplies.

If you have ever prepared statements in "dollar-only" from figures that included pennies, you have some idea of the time involved in rounding and balancing. With the whole-dollar method of accounting, analysis and report preparation, calculation and computations as well as classifying and distributing of sales, payrolls, costs, expenses and inventories for internal use actually become more simple. This work can be done in less time and more accurately.

Reduction in Errors

This area of thought brings to my mind an address given by a controller to a group of finance officers. He began his talk by displaying a large printed card with the following figures on it:

$$\begin{array}{r} \$605.91 \\ 3.99 \\ 20.26 \\ \hline \$629.16 \end{array}$$

In the course of his paper, he pointed out that the total above contained five digits and a decimal point, which is the approximate average number for posting. He likewise pointed out the savings that could result from dropping the decimal and pennies in the subsequent postings of these figures. He also discussed the potential savings that could be realized in the matter of eliminating errors and reducing verification time.

Another card was displayed, showing rounded amounts of the figures on the first card:

$$\begin{array}{r} \$606 \\ 4 \\ 20 \\ \hline \$629 \end{array}$$

It is very quickly apparent from this illustration that an error in footing is present in the second set of figures. But how many would note the error in the first set of figures? The method of determining the error in the first set is normally to add the last three columns while the second set requires but a glance. After arriving at a different answer in the addition of the first set, you probably would proceed to re-add the same three columns in order to prove that you were right. I believe the controller illustrated his point very well. With fewer digits to post, add, summarize, etc., the mathematical chances for error are reduced proportionately. In all but a small group of accounts, no pennies would be present in whole-dollar accounting.

The most important point in the illustration of figures above was that of locating an error and verifying it. The incidence of error and the consequent search for the error is most frequently done under closing and statement pressures. The alleviation of any of the pressures at this time helps speed the closing and the statement preparation. Thus, reducing errors by whole-dollar accounting can result in an increased productivity in each of the following ways:

1. Less errors, i.e., more work of higher quality accomplished
2. Less time needed for locating errors and verification after they are found.
3. Less pressure at critical times, faster closings, quicker statements.

Employees and Cents-Less Accounting

The attitude and morale of employees undoubtedly affects the quantity and quality of work performed. The producing of errors has a detrimental effect on employees' morale which may or may not be apparent. Errors cannot be dismissed as just a product of careless employees for any system which requires human intervention will unavoidably produce some errors. So, then, it is a question of how to give the employees an opportunity to reduce errors.

In certain tests that were made, a distinct reduction of incidence of error resulted when there were fewer elements to be perceived and recorded. In whole-dollar accounting there are fewer elements, digits, to be observed than in dollars-and-cents numbers. It follows that there is a greatly reduced probability for making an error in reading, transcribing, either by hand or machine, a number involving only dollars. The effect this could have on employees is truly not measurable; however, most employees pride themselves in the small number of errors performed. Hence, a system which could reduce the percentage of errors now being made would have a good morale-building effect on all employees concerned.

As stated in an article (*The Controller*, April 1952, Robert H. Birkhold), "Handling pennies—and especially searching for trivial errors in the cents columns—can make bookkeping a pretty menial task. Whole-dollar accounting can make the same job assume greater importance. The employee will feel that he is contributing more to the department, and will mentally move to a higher position. This lift in morale can have other, and possibly far-ranging, effects. This system, like any other that is new, must be well planned, adequately explained and even sold to employees whom it will affect. With effective guidance, the employee will accept the change and actively participate in making it a success. Once this is accomplished, he will feel a part of this new system. This can lead, given proper encouragement and guidance, to a more active participation in originating and facilitating further systems and procedures improvements. The employee will feel that the heretofore "conservative" accounting management has abandoned a tradition—the subservience to the penny detail of bookkeeping. This departure will be tangible evidence that other reasonable suggestions for improving methods will be well received. This is of tremendous importance, for ideas and suggestions can save thousands of dollars upon application. Of course, this flow of ideas must receive proper encouragement and sincere consideration, possibly by two-way free and open discussion and evaluation.

Therefore, whole-dollar accounting may have a strong impact on the human aspect of business operations by:

1. Improving the morale of the employee in accounting.
2. Relieving some menial aspects of the jobs, giving them more "importance".
3. Being the key to unlock the vast store of ideas and suggestions which may be made by the personnel.

Installing Whole-Dollar Accounting

As in any other system and procedure change, this work simplification technique should have careful planning. The planning should lead to:

1. The elimination of pennies at the very earliest possible point in accounting operations.
2. Thorough instruction of accounting personnel, to ensure their complete understanding and cooperation.

The next step is to consider methods of installation, i.e., either to place the system in operation in all areas of accounting at the same time or to install

it gradually in one area at a time. The system is simple enough that it may be installed in all areas at once without too much difficulty.

The most common method of rounding to whole-dollars is as follows: pennies are rounded to the nearest dollar; amounts ending in 50¢ are rounded to the nearest *even* dollar ($4.50 is rounded to $4 and $5.50 is rounded to $6). The rounding rules should be followed automatically without consideration of the aggregate adjustment in any series of transactions. No attempt should be made to reduce the penny adjustment by "forcing" the rounding of any figures.

The only exception to the above rule would be certain isolated cases. The extreme situation might be a stores requisition area in which a great majority of individual requisitions total less than 50¢. This could be handled in several ways but only after a careful examination of the particular situation should a solution be chosen. The solution might be:

1. Accumulate the requisitions in batches and round each batch in the standard manner.
2. Round at a different point than 50¢, for example, 30¢. All amounts over 30¢ to a dollar, amounts under are dropped. However, the point chosen must be statistically sound, otherwise this area of the system would not function properly.

When whole-dollar accounting is applied, pennies are the exception rather than the rule. Pennies would be used only in areas where outsiders were concerned and could be eliminated from entries to rounded accounts at the earliest practical point. In the rounded amounts, the penny positions are not indicated by a dash or double zero. All amounts are assumed to be rounded, unless pennies are specifically indicated. It is very important that this be clearly understood and followed by all personnel in order to avoid confusion in reading amounts properly.

A penny adjustment account should be used to receive the pennies caused by rounding and to preserve the double entry system. Pennies therefore are not lost but are controlled even though not recorded individually.

Whole-dollar accounting can help you; if not in the whole accounting system, surely in selected areas. If the article above has stimulated your thinking, further study on the subject would probably be very valuable. The system itself is very simple and would prove to be one of the easiest to install.

Half a Loaf

by PEDRO J. GUTIERREZ*

THE ADVENT of electronic computers and data processing equipment has made the dream of integrating the flow of business transactions a reality. However, we are constantly exposed to the problem of dealing with conflicting interests whenever integration is attempted. There is no standard approach to integrating, and everyone has his own idea as to what the best approach should be.

Does every aspect of the integration process have to be worked out before we begin the actual application? We do not think so! There is much that can be done for improving our operations today. We can reduce the problem down to workable units and implement those portions for which we have a reasonable solution. It is remarkable how much can be done along these lines. Here, for example, are some of the factors which must be given ultimate consideration in integrating the production control operation in a factory:

1. Bills of material and manufacturing drawings.
2. Engineering changes.
3. Sales forecasts.
4. Perpetual inventory records.
5. What is going to be produced (production requirements).
6. How we are going to produce it (method cards).
7. When we are going to produce it (production schedule).
8. Control of the flow of materials (standard material requisitions).
9. Control of obsolescence, shortages, surpluses, etc.

Should we wait until all the problems connected with the above considerations have been resolved and until everyone is in agreement, before integrating even a portion of the production control operation, or should we attack each problem area in a logical sequence and effect partial implementation on the way to the ultimate goal of complete integration? What if the improvement yields only fifty percent of what we are aiming for? What if the integration does not occur all at once? As long as we are taking forward steps we should not be concerned. Although complete integration is our final goal, we must recognize the difficulties inherent in accomplishing it. We can obtain a return on our time and effort investment by implementing improvements as they become evident. This is economically good sense. We should not deny ourselves partial progress because of the all-or-nothing-at-all attitude. A half a loaf has been and will always be better than none.

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Integrating Control and Allocation of Service Section Expense

by LELAND G. SPENCER

HOW OFTEN have we heard these remarks, "I am paying too much for these service sections?", "How can I make a profit when I have to carry these non-productive guys on my back?", "The accounting boys are not fair in allocating service section expense to me," etc., etc., etc. Most of us have heard them for many years and many are still confronted with them today. This is a subject which, unfortunately, remains an irritating one in many plants. To superintendents or foremen of productive centers, it is particularly irritating as, generally, they are of the opinion that all service section expenses are too high and are allocated to productive sections on a basis which is unfair and unrealistic. It is my sincere opinion that these feelings can be avoided with almost complete agreement on the part of all concerned. I say this in view of the progress which we have made in our own plants during the past two to three years. We are firmly sold on the new procedure which we have in place for controlling service section expense and, in turn, allocating this expense to productive sections on a realistic basis.

Cause of Expense—Determinant of the Basis for Allocation

After 25 years of "hair losing" experience in the cost accounting and general accounting functions, servicing the "hard boiled" as well as the "elite", I am firmly convinced that the biggest job yet to be done in the cost control area is that of engineering sound cost control and allocation procedures in the service section areas. This will serve to convince the supervision of the productive sections or centers that the expenses of the service sections or centers are (1) justified and reasonable for the actual service rendered, (2) controlled and measured in a professional manner and (3) allocated to productive sections or centers on a sound basis, i.e., a basis which recognizes the dictating force behind (or cause of) variable service section expense and allocates it in

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line with this force. Obviously, this must be done for more reasons than simply that of satisfying productive section supervisors. We need it for purposes of reflecting accurate product profitability, in break-even or "p/v" analysis, etc.

It is essential that the expenses of a specific manufacturing process or center be clearly segregated between direct and allocated, i.e., those incurred directly within the process and those incurred by service sections. It is not difficult to isolate, accumulate and report the two types of expenses independently. Neither is it difficult to budget and measure performance in the direct expense area. However, accurate budgeting and measurement of performance in the service section area is work which requires much closer analysis and sound original thinking with respect to the basis of allocation of expense to productive sections. Arbitrary allocations should be avoided in order to ensure accuracy of stated profitability of specific products.

In many companies, it is common practice to budget expenses of specific service sections and to measure performance against these budgets by employing sales, plant output, plant direct labor or some other common item as the activity unit. Generally, this practice results in a performance measurement which is not consistently accurate and one which can be improved upon materially. Starting with the budget for 1957, we designed and initiated an entirely new approach to measuring performance of service sections and allocating their expense to productive sections. The basic feature of this procedure lies in the fact that actual allocation of service section expense to productive sections is identical in amount to current variable budget allowance to the service sections. This follows from the fact that budgeted variable expenses of service sections are tied to the activity units of the productive sections that they serve.

Distinction between Productive and Service Sections

Before giving a descriptive picture of the new procedure, it would undoubtedly be beneficial if we first outlined the old procedure and the real problem which it presented with respect to sound cost control and the reflection of accurate profitability by product. In this respect, our problem was probably no different than that which many plants are experiencing today. Some plants probably have a sound procedure in place and one that may even be better than our new one.

First of all, what do we consider productive sections as differentiated from service sections? A segregation of the productive sections within one of the plants of the Plastics Department of General Electric is presented below, but first, let us review the productive sections in one of our plants.

Compression molding is a manufacturing process area requiring heavy investment in presses where molding compounds, either in powder or pellet form, are placed in molds and, through a combination of hydraulic pressure and steam heat, are compressed into a semi-finished molded part. Typical items produced in this area would be telephone handsets, agitators for automatic washers, camera components, etc. The major process costs in this area are depreciation, operation and maintenance of equipment, with direct labor being a much smaller factor.

Compression finishing is the area in which molded parts are taken to be tumbled, drilled, filed, buffed, etc., either by hand or by specialized machinery. Except for a few machines, the investment is low, with the predominant cost being direct labor.

Injection molding is a manufacturing process requiring extremely high investment per employee and one for which the actual process is somewhat the reverse of that in compression molding. Here the molding compound, in powder form, is placed in hoppers above the press, heated into a semi-liquid form in electrically heated chambers, and injected into cold molds under extreme pressure. The cycles under this process are much shorter than those in compression molding. Examples of products made in this area would be interior trim and accessories for refrigerators, radio cabinets, cosmetic containers, etc. Here again, the major costs are depreciation, operation and maintenance of equipment.

Injection finishing is a process of the same type as described under compression finishing, with the exception that more specialized work is also carried on, such as painting, hot stamping, assembly, etc. Again, direct labor is the predominant cost.

Extrusion is a process similar to injection molding, except that the product is extruded in a continuous form, rather than in individual parts. Common items which are produced in this area include various types of tubing for many applications, sheets for fluorescent light fixtures, caps for protection of threads on metal items, etc. Costs connected with equipment are the major factor here.

Silicone fabricating is a manufacturing process in which silicone rubber is compounded, extruded, molded and finished in a wide assortment of shapes, sizes, weights and colors. It is a specialized type of operation with no set pattern of cost content. Silicone rubber is a relatively new item and very expensive. Primarily, applications for this material are in areas where the product is subjected to extreme ranges in temperature changes and where little change in texture or properties take place during such temperature changes.

Mold or tool is required by each product that we produce and is billed to the customer and remains his property. While they represent a production or process facility, we treat their fabrication as a direct operation.

Now, let us review the areas which are treated as service sections.

Administrative: the salary and expenses of the plant manager, his secretary and members of his staff, which consists of each product line supervisor and certain service section supervisors.

Materials control: all the expenses connected with planning, purchasing, expediting, storing, handling and shipping materials, segregated into three natural areas, i.e., (1) central production, (2) purchasing and (3) receiving, storage and shipping.

Quality control: the total expenses involved in checking in and testing materials, process inspection, final product inspection, laboratory tests and casual quality audits. This includes materials used as well as salaries, wages and other expenses of employees in each area.

Planning and methods: the salaries, wages and other expenses of personnel engaged in process planning, methods engineering, time-study work, cost reduction activities and other types of manufacturing or industrial engineering.

Maintenance: all expenses incurred by each of the maintenance groups, except wages of maintenance workers, which are charged directly to the productive sections being served.

Power: costs of electric energy distribution, hydraulic power, compressed air, process and heating steam, etc.

Financial: total salaries, wages and other expenses of financial personnel serving the plant.

Personnel: salaries, wages and other expenses of personnel office and dispensary, employee meeting attendance expense, and other related expenses.

At the end, it might be noted that no productive or service section expense includes any assessment from department staff or any general company expense, i.e., plant expense is only that incurred directly by the plant management.

Major Weaknesses of the Old Procedure

Now that a picture has been given of the productive and service sections and the basic activity carried on in each, let us take a quick look at the old procedure which we followed in controlling and allocating service section ex-

pense. First of all, we built fixed and variable budgets for each service section on the basis of anticipated service required for the annual sales volume budgeted. These budgets, we believe, were well thought through, with budgeted expense being reasonable. Second, the activity unit or measurement base selected was total plant sales.

Current measurement of performance, therefore, was simply a comparison of actual expense in each service section with the variable budget allowance which would be applicable to the actual volume realized. No weight was given to a changed product mix or to production which was greater or less than net shipments (gross sales less customer returns). For purposes of allocation to productive sections, actual expenses were prorated in exactly the same ratio as that budgeted before the start of the new year, e.g., when it was determined that 35 percent of the annual budget for quality control was applicable to compression molding, then 35 percent of current actual expenses was charged to this area. Obviously, this represented an undesirable procedure. Since it was the general procedure, it should be pointed out, in all fairness to our plant people, that there was some degree of deviation from it when there was a major change in product volume. However, it was arbitrary and not correctly engineered.

The major weaknesses in this procedure can be spelled out as follows:

1. Lack of research in determining actual dictating force behind (or cause of) variable expense.
2. Failure to factor a changing product and volume mix in calculating current budget allowance, as well as in the allocation of expense to productive sections.
3. Failure to recognize a changing material vs. conversion cost situation within productive sections. Actual expenditure of plant expense is occasioned by the manufacturing activity, actions of men and machines, with the material content having little effect. Therefore, budget allowances should be tied to the conversion cost content of manufacture only. The inclusion of material cost in the measurement base results in erroneous allowances in many instances.
4. Conflict of measurement bases—one for productive and another for service sections. Measurement in our productive sections, as far as direct expense was concerned, fortunately, was on a sound basis, i.e., actual activity within that unit. However, measurement of service sections was against a total plant activity unit, which did not recognize the facts.
5. Mis-statement of product profitability. We have been building break-even charts and profitgraphs for many years and using these

in comparing actual product profitability performance currently. Under our old procedure for allocating service section expense, these comparisons were not necessarily accurate.

Main Tasks Assigned to the New Procedure

In reviewing the need for a new procedure, we had certain basic objectives in mind, which represented "musts". These were:

1. Sound measurement of service section performance through recognition of activity (productive section output) dictating variance in expenses. This certainly would make sense, as there should be no service section variable expense unless there was activity within the product sections. Further, any change in this expense should be directly related to production activity.
2. Allocation basis completely integrated with that of measurement. In other words, if it is sound practice to tie service section expense to productive section activity, then current budget allowance for the service sections and dollar allocation to the productive sections should be one and the same.
3. No allocation of over/under-performance of service section expense to productive sections. Omission of such allocation is necessary if we are to accurately measure product profitability against break-even charts or profitgraphs.
4. Clarity guaranteeing acceptance by upper and lower levels of supervision, which is a real need if we are to achieve optimum profit performance through whole-hearted participation.
5. Contribution to sound product profitability analysis (p/v analysis). This is extremely important, as the value of such guides is entirely dependent upon the accuracy of our segregation of costs and expenses to fixed and variable.

We believe that each of these objectives is achieved in our revised procedure for controlling and allocating service section expense to productive sections. A review of the new procedure will assist in an appreciation of this conclusion.

New Approach to the Service Sections Budgeting

First of all, for each service section, we followed the normal procedure for setting up a variable budget. Consideration was given to the activity that each productive section was budgeting, actual expenditures over several periods in the service section, unusual service requirements of specific productive sections,

predicted wage and indirect material cost levels, planned organization and process changes, etc. After several critical reviews by the plant manager and financial people, we were ready for a new type of review. Behind closed doors, with only the top supervision of each *productive* section and the plant accountant in attendance, the approved budget of each service section was reviewed in complete detail. On occasion, the plant manager was in attendance. In our opinion, this represented the most constructive step that we had taken in connection with budgeting in a long time. It was a "free-for-all" affair and the reader can well imagine the type of discussion carried on at times. However, the results were extremely gratifying in the light of past criticisms of service section expense. In very few instances was it necessary to call in a service section supervisor. When properly explained, specific expenses were accepted as being reasonable.

Now for the tough job. After we had gained acceptance of each service section budget and this took quite a few hours, the next job was to obtain an agreement from each productive section supervisor on expenses that he was responsible for and should, therefore, carry. It was not surprising to learn how little work was done for each section and to find that the value of this added up to less than ⅓ of the total expense! However, we were ready for this attitude, having anticipated it when we designed the new approach. For some time before this meeting, our people had made extensive surveys of the actual demands placed on service sections, with the result that answers were ready for about every complaint. It was surprising, after all of the complaining, how few substantial changes were made in our preliminary allocations. As a matter of fact, the productive section supervisors were very happy to have the opportunity to review the "service" budgets, were surprised in many cases to learn that they really were responsible for so much of these expenses, and were convinced that we really had made a constructive step in budgeting.

Breakdown of Budgeted Service Expenses

Having gained acceptance of the service section budgets as well as which degree of each should go against productive section budgets, it was comparatively easy to break out the fixed and variable elements and inform each productive section supervisor of the basis of allocation. To explain the procedure more clearly, a set of exhibits have been prepared for the readers' guidance. (For obvious reasons, the numbers which appear on these charts are strictly for illustrative purposes only and do not bear any resemblance to those reflected on the actual budgets.)

Variable Budget Allowance
Quality Control Section - Decatur
Year 1959

Account No.	Account Title	Budget Allowance by Account: Fixed expense Per week	Fixed expense Total	Variable expense Amount	Variable expense Pct. to total	Total budget
604	Gauges	$ 67	$ 3 484	$ 2 345	1.84%	$ 5 829
605	Inspectors	947	49 244	89 635	70.18	138 879
612	Clerical	55	2 860	1 430	1.12	4 290
619	Tel. & tel.	16	832	1 400	1.10	2 232
620	Meetings	30	1 560	780	0.61	2 340
624	Emp. welfare	-	-	300	0.23	300
627	Overtime	-	-	2 690	2.11	2 690
631	Night shift premium	45	2 340	4 160	3.26	6 500
635	Nondurable tools	-	-	2 100	1.64	2 100
636	Shop supplies	-	-	850	0.67	850
639	Office supplies	32	1 664	650	0.51	2 314
658	Shop work	-	-	450	0.35	450
660	Rearrangement	-	-	1 800	1.41	1 800
661	Travel & entertain.	37	1 924	1 600	1.25	3 524
668	All other	20	1 040	300	0.23	1 340
673	Maint. - equip.	65	3 380	1 860	1.46	5 240
677	Maint. - tools	22	1 144	950	0.74	2 094
678	Empl. benefits	160	8 320	14 415	11.29	22 735
	Total	$1 496	$77 792	$127 715	100.00%	$205 507

Allocation to Productive Sections

Product section	Fixed expense Per week	Fixed expense Total	Variable expense Total	Variable expense Product activity	Variable expense Pct. to activity	Total budget
Compression molding	$ 480	$24 957	$ 40 973	$1 484 540	2.76%	$ 65 930
Compression finishing	199	10 338	16 972	179 600	9.45	27 310
Injection molding	352	18 304	30 051	1 697 770	1.77	48 355
Injection finishing	106	5 489	9 011	203 400	4.43	14 500
Extrusion	19	1 004	1 648	171 700	0.96	2 652
Silicone	175	9 101	14 941	612 350	2.44	24 042
Tool	165	8 599	14 119	451 100	3.13	22 718
Total	$1 496	$77 792	$127 715	$ X	X%	$205 507

EXHIBIT 1

Exhibit 1 shows a complete breakdown of the budget for the quality control section—one of the service sections identified earlier. On the lower portion of this exhibit is shown the allocation to the productive sections. For example, for compression molding, our analysis indicated that this section should carry 32.1 percent of the total expense in the quality control area. Therefore, this degree in both fixed and variable areas has been allocated to this productive section. Under "product activity" is recorded the budgeted output for each productive section. In this instance, compression molding has budgeted $1,484,540 of standard "conversion" cost, which represents standard direct labor and standard factory overhead. We have found that this is the activity unit in this process to which variable expenses can be accurately tied. This seems to hold true regardless of equipment size. The same activity unit is used in injection molding, extrusion and silicone. The activity unit in the other productive areas is standard direct labor. Because of the use of differing measurement bases, no total can be reflected under "product activity"

or "percent to activity". The breakdown shown on the exhibit will be used throughout the year in (1) calculating the current variable budget allowance for this service section and (2) allocating expense to the various productive sections. The amounts in each instance, budget and allocation, will be identical. For example, compression molding will be charged $480 per week fixed and variable in an amount equal to 2.76 percent of its actual "activity". The total current charges to each productive center will equal the current budget allowance for the service section. This is certainly reasonable, as the supervisor of the service section has agreed to control his expenses within these limits. In addition to achieving sound measurement in the service section, we gain the acceptance and cooperation of the supervisor of the productive section; he can concentrate almost entirely on controlling his own direct expense. Allocations should not affect his performance as his charges and budget will be identical.

Variable Budget Performance
Quality Control Section - Decatur
March 1959

Account No.	Title	Current Budget Allowance: Fixed expense Per week	Fixed expense Total	Variable expense Pct. to total	Variable expense Amount	Total allowance	Actual expenses	VB%
604	Gauges	$ 67	$ 335	1.84%	$ 231	$ 566	$ 736	30
605	Inspectors	947	4 735	70.18	8 824	13 559	12 880	5*
612	Clerical	55	275	1.12	141	416	428	3
619	Tel. & tel.	16	80	1.10	138	218	237	9
620	Meetings	30	150	0.61	77	227	142	38*
624	Employee welfare	-	-	0.23	29	29	59	102
627	Overtime	-	-	2.11	265	265	451	70
631	Night shift premium	45	225	3.26	410	635	501	21*
635	Nondurable tools	-	-	1.64	206	206	374	81
636	Shop supplies	-	-	0.67	84	84	134	59
639	Office supplies	32	160	0.51	64	224	127	43*
658	Shop work	-	-	0.35	44	44	66	50
660	Rearrangement	-	-	1.41	177	177	72	59*
661	Travel & entertain.*	37	185	1.25	157	342	234	32*
668	All other	20	100	0.23	29	129	178	38
673	Maint. of equip.	65	325	1.46	184	509	525	3
677	Maint. of tools	22	110	0.74	93	203	217	7
678	Employee benefits	160	800	11.29	1 420	2 220	2 019	9*
	Total	$1 496	$7 480	100.00%	$12 573	$20 053	$19 380	3*

Calculation of Current Budget Allowance

Product Section	Fixed expense Per week	Fixed expense Total	Variable expense Activity	Variable expense Pct. to activity	Variable expense Amount	Total allowance
Compression molding	$ 480	$2 400	$169 890	2.76%	$ 4 689	$ 7 089
Compression finishing	199	995	19 305	9.45	1 824	2 819
Injection molding	352	1 760	127 390	1.77	2 255	4 015
Injection finishing	106	530	17 104	4.43	758	1 288
Extrusion	19	95	30 300	0.96	291	386
Silicone	175	875	63 404	2.44	1 547	2 422
Tool	165	825	38 617	5.13	1 209	2 034
Total	$1 496	$7 480	$ X	X%	$12 573	$20 053

*Denotes negative

EXHIBIT 2

Sound Measurement of Service Section Performance

On Exhibit 2 we have a calculation of actual performance against variable budget made in March by the quality control section. While the "cart is before the horse" in the instance of this report, we have purposely done this in order to have the format of Exhibits 1 and 2 as alike as possible. We should first look at the lower portion where the current budget allowance is calculated.

We operate on a fiscal calendar basis, with each quarter being made up of successive periods of 4, 4 and 5 weeks. With March being a 5-week month, there are 5 weeks of fixed expense. Under variable expense, we have recorded the actual "activity" of each productive section and calculated the allowable variable expense by extending the "activity" by the percent activity ratios shown on Exhibit 1. The result of our calculations shows $7,480 of allowed fixed expense, and allowed variable expense of $12,573, for a total allowance of $20,053. These totals, in turn, are carried to the upper portion of the exhibit and broken down in the same manner as the annual budget shown on Exhibit 1. In actual practice, our reports are run on I.B.M. equipment for which master cards on budget allowances are maintaned. All that needs to be done currently is to "feed in" the actual activity unit. Our reports show indirect labor, other expense, total expense and budget. These totals are shown for both current month and year-to-date.

Allocation Integrated with Measurement

Exhibit 3 details the allocation of expense of the various service sections to the compression molding section. Actual measurement and allocation is carried out by the same procedure as has been illustrated on Exhibits 1 and 2. The total expense shown on this exhibit, together with the budget of direct

Service Station Variable Budget Allocation
Compression Molding Section-Decatur
Year 1959

Service Section	Variable Budget Allocation: Fixed expense Per week	Fixed expense Total	Variable expense Pct. to activity*	Variable expense Amount	Total allocation
Administrative	$ 638	$ 33 176	0.16%	$ 2 375	$ 35 551
Materials control	394	20 488	2.22	32 957	53 445
Quality control	480	24 957	2.76	40 973	65 930
Planning and methods	240	12 480	0.37	5 493	17 973
Maintenance	1 401	72 655	4.64	68 883	141 738
Power	494	25 688	0.46	6 829	32 517
Financial	437	22 724	3.19	47 357	70 081
Personnel	246	12 792	1.33	19 744	32 536
Total	$4 530	$225 160	15.13%	$224 611	$449 771

*Budgeted activity for this section $1,484,540 (Standard conversion cost)

EXHIBIT 3

expense in the compression molding section, represents the total budgeted factory expense for this production area.

From these exhibits and the explanation of the new procedure, it will be obvious that we have achieved our basic objectives. We find the new procedure to be working very well and we have complete acceptance on the part of all supervisors.

Measurement of Product Profitability Also Improved

While we have been more than satisfied with the success of this new procedure in so far as control and allocation of service section expense are concerned, from top management's viewpoint the outstanding product of this procedure is the achievement of a sound basis for forecasting and measuring

Decatur Plant
Compression Molded Products
March 1959

	Amount	% Sales	VB%
Sales	$ 489 711	100.0	9*
Gross margin - standard	129 600	26.5	4*
Cost variances			
Volume (Marketing)			
I. M. E.	9 900*	2.0*	6*
P. E. C. E.	3 600*	0.8*	4*
Total	13 500*	2.8*	5*
Performance (Manufacturing)			
Material - Price level	1 550*	0.3*	-
Material - Usage	2 175	0.4	-
Labor - Wage level	1 122*	0.2*	-
Labor - Usage	905	0.2	-
I. M. E. - Productive	3 745	0.8	-
I. M. E. - Service	6 110*	1.3*	-
I. M. E. - Inventory change	2 400	0.5	-
P. E. C. E.	3 794	0.8	-
Total	4 237	0.9	-
Total cost variances	9 263*	1.9*	37*
Gross margin - adjusted	$ 120 337	24.6	4
Gross margin - controllable **	$ 142 619	29.1	

*Denotes Negative
**Eliminates volume, price level, wage level, and service section I. M. E. variance

EXHIBIT 4

product profitability. For roughly ten years, we have been pioneering in break-even analysis and profit-graph construction, with each year witnessing improvement. However, in measuring against these currently, we realized that the numbers reflected were influenced by the over or under-charging of service section expense to specific products. With integration of control and allocation of expense in the service section area completed, we believe that we have made the most constructive step yet and that we now have a truly accurate basis for forecasting and measuring product profitability.

In this connection, Exhibit 4, an example of how we have improved the reporting of product profitability, reflects the profitability of the compression product line for March. (Numbers, of course, not factual.) Here is seen the effect of nonperformance on the part of service sections—$6,110 or 1.3 percent of sales. While, in the final analysis, this loss must be written off against current sales, it is eliminated when we measure the actual profitability of this line. Before the integration of the new procedure, this variance was "buried" in the overhead variance of the productive section. Even if the amount had been known, it would have been of an entirely different magnitude, as we had no sound basis of allocation of service section expense to productive sections. Now we believe that we do, with the result that we have a more accurate measurement of product profitability as well as a sound basis for controlling service section expense.

The Pool Method of Setting Overhead Rates

by ROBERT K. McLAIN

STANDARD COSTING has long been recognized as one of the most appropriate systems for use in companies manufacturing a complex product line but many problems arise in the allocation and absorption of overhead costs. Those costs incident to the procurement, receiving, storing, handling and accounting for materials can amount to a significant portion of total overhead costs. In addition, certain management option or policy expenses such as engineering, development, warranty, tooling, and research costs, may be included in the total overhead pool. The inclusion of management option expenses, together with large amounts of material related costs in manufacturing overhead, renders the job of establishing meaningful departmental overhead rates very difficult.

Complexity of Overhead Costs—Basic Difficulty

Close analysis of overhead costs indicates that many categories of expense which are accounted for under a single definition are actually made up of elements which should be allocated to cost centers by different methods or absorbed into product by the use of a combination of bases. For example, a production control department may employ certain people to schedule machine shop orders, others to prepare assembly line schedules, and still others to schedule incoming shipments from supplier plants within the company. We can readily allocate to cost centers the portions of the production control department expense which pertain to machine shop and line scheduling, but where should we allocate that part which pertains to scheduling material from other plants? One answer might be to determine the cost centers in which this material is first consumed. If this method of allocation is used, should the expense be absorbed on a direct labor dollar, prime cost, machine hour, or material consumed basis? A material-consumed basis would be best for this expense but it would not be at all appropriate for many other cost center expenses.

The use of multiple bases for absorbing overhead within each cost center is a complex, expensive procedure. The possible benefits might not prove to be worth the expense. A single-base absorption practice, however, creates two unfortunate inequities. First, overhead rates in those machining departments to which sizable amounts of material-related and optional costs are allocated be-

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come relatively high, causing the standard cost of finished parts processed in those departments to be correspondingly high. This, in turn, invites purchasing and engineering people to make unfavorable make-or-buy comparisons without fully realizing the make-up of overhead factors included in the standard cost of the particular manufactured part. A second difficulty arises in comparing the cost of finished models requiring many hours of assembly labor with those models which have a large ready-for-use content but fewer assembly hours. Assembly departments bear the bulk of the costs related to ready-for-use materials plus their share of optional costs. A high-volume standard model requires relatively few hours to assemble. The result is high overhead rates which bear heavily on the low-volume custom model because it requires considerably more assembly hours. These two factors limit the value of standard costs in the comparison of gross profits between models.

A Method to Overcome Difficulties

The pool method of setting overhead rates can overcome these difficulties. The prime objective of this method is the setting of model standards which are truly comparable regardless of differences in production methods or content of ready-for-use parts. This objective is accomplished by applying overhead to product through the most direct channels possible. Material-related costs follow the material into product rather than labor. Certain overall or management policy costs are added to product costs on an overall basis rather than being added to each dollar of labor expended. Four steps are necessary to establish standard overhead rates under this method:

1. Allocation of forecast overhead expenses into pools.
2. Allocation of cost center directed expenses to individual departments.
3. Translation of production forecast into terms of direct labor by cost center, material requirements and value of finished production.
4. Computation of rates.

Allocation of Forecast Overhead Expenses

Overhead expenses are broken down into four categories or pools: cost center direct, inter-plant materials, purchased materials and overall expenses. Exhibit 1 indicates some of the types of expenses allocated to each department.

In general, direct departmental expenses such as foremen's salaries and manufacturing supplies are allocated to the cost center direct pool in their entirety. Expenses of service departments such as production control, standards, cost accounting, engineering, etc. must be split according to the nature of their activi-

Allocation of Overhead Expense to Pools
October 1, 1958 - September 30, 1959

Description	Forecast 12 months expense	Cost center direct	Inter-plant material	Purchased material	Overall pool
Foremen's salaries (production depts.)	$ 160,000	$ 160,000	$	$	$
Supplies	500,000	500,000			
Production control dept.	200,000	100,000	100,000		
Purchasing dept.	100,000			100,000	
Material storing	100,000		30,000	70,000	
Material handling	125,000		45,000	80,000	
Warranty expense	300,000	100,000	50,000	50,000	100,000
Sale of scrap	(50,000)			(50,000)	
Highway trucking	50,000		50,000		
Maintenance expense	375,000	250,000	25,000	50,000	50,000
Engineering dept.	1,725,000	500,000	750,000	100,000	375,000
Totals	$15,000,000	$9,000,000	$1,000,000	$2,000,000	$3,000,000

EXHIBIT 1

ties. The production control department's expenses can readily be split between cost center direct and inter-division material pools through analysis of the number of people working on scheduling production versus the number scheduling material in from other plants. Expenses of certain other departments, such as the purchasing department and the highway trucking department, fall readily into one or the other material pool. Material storing and handling departments can be allocated on the basis of volume stored or handled. Warranty expenses can be allocated through analysis of claims paid, to determine responsibility. Claims paid of a policy nature are allocated to the overall pool, as are certain areas of engineering, development and maintenance expense.

The cost center direct pool must next be allocated to individual direct departments. This is done by employing many of the standard allocation bases universally used in overhead allocation. Certain direct expenses can be allocated on the basis of the current year's experience. Other bases employed are area (heat, light, building depreciation), number of employees (personnel department, payroll department), and value of equipment (depreciation of equipment, property taxes). Many of these calculations, of course, are made at the time Step 1 is performed. For example, personal property taxes are allocated by breaking down the assessed value of all personal property among purchased inventories, inter-plant inventories, and machinery, equipment and work-in-process inventories by cost center. Personal property taxes allocable to finished inventories are allocated to the overall pool although a good case can be made for treating all costs of maintaining a finished goods inventory as selling expense.

Adjustments to Production Forecast

Translation of a twelve months sales forecast into terms of direct labor and material consumed can be done with a fair degree of accuracy by extending the forecast production schedule by the number of standard hours required to produce each model. Provision must then be made for the extra labor required to produce special attachments and variables, and to supply the service division with their requirements. Extending these hours by the standard labor rates for each cost center yields the forecast direct labor dollars necessary to build and ship the forecast volume. Similar computations are made to arrive at the forecast amounts of material requirements.

At this point, a decision must be reached as to the level of production at which overhead rates are to be set. If the sales forecast and the resulting forecasts of direct labor, material consumption and overhead expenses indicate a below normal production for the coming year, it may be advisable to adjust the forecast figures upward, before making the overhead rate computation.

Computation of Rates

Exhibit 2 is a summary outline of the actual computation of rates. The over-

Computation of Standard Overhead Rates
October 1, 1958 - September 30, 1959

Cost center	Forecast expenses	Forecast direct labor	Forecast material consumed	Forecast model build*	Rate
Machining					
10	$ 1,500,000	$ 500,000			300%
11	1,000,000	200,000			500%
12	1,200,000	400,000			300%
Fabricating					
20	1,600,000	400,000			400%
21	700,000	350,000			200%
Assembly					
31	2,000,000	1,000,000			200%
32	1,000,000	400,000			250%
Sub total	$ 9,000,000	$3,250,000			
Inter-plant	1,000,000		$6,000,000		17%
Purchased	2,000,000		8,000,000		25%
Overall	3,000,000			29,050,000	10%
	$ 15,000,000	$3,250,000	$14,000,000	$29,050,000	

*The transfer of the standard cost of models completed from work-in-process to finished goods.

EXHIBIT 2

head pool totals from Exhibit 1 are entered as forecast expenses (Column 1), with the cost center direct pool having been broken down by cost center. Column 1 divided by Column 2, 3, or 4 yields the standard overhead rates to be used in the coming year.

Computation of Model Build

Direct labor	$ 3,250,000
Material consumed	14,000,000
Overhead absorbed-cost centers	9,000,000
Overhead absorbed-material	3,000,000
	$ 29,250,000
Less Forecasted increase in work-in process	200,000
	29,050,000

EXHIBIT 3

Exhibit 3 demonstrates how material, labor and overhead forecasts are combined to arrive at the base figure which is to be used to compute the overall overhead rate. In practice, this figure would be adjusted to eliminate estimated scrap and the value of replacement part shipments.

Computation of Standard Costs

Once the standard overhead rates, labor rates, and unit material standards have been set, the next step is to build finished part, sub-assembly and final model standard costs for use in pricing the physical inventory taken at the beginning of the year. These standards will then be used for costing for one year. It may not be practical to change standards during the year because of the difficulties of carrying changes through all the stages from raw material to finished product. Changes in methods or parts lists during the year are accounted for by means of variances.

Punched card equipment is very useful in building unit standards. A route sheet deck, which contains the latest routings of all finished parts, is maintained in the tabulating department throughout the year. One card is punched for each labor operation and for each material component of every manufactured part and sub-assembly. The labor cards contain the operation number, the department number, machine code, and standard hours per piece. The material cards contain the steel code or component part number, the quantity used and the operation during which the material is added or consumed. The labor cards are extended on the calculator by multiplying the standard hours times the departmental standard labor rate, and this product times the departmental overhead

rate. The extended labor and overhead amounts per piece by operation are automatically punched into the labor cards Material standards are extended more slowly in logical steps:

1. Sort out material cards showing steel usage, and extend by steel standards. Punch account number and amount into cards, and extend by material overhead rates.
2. Match other material cards against rough casting and forging standards, extend by unit standards, and punch account number and amount into cards. Extend by material overhead rate.
3. Tabulate labor and material cards for each manufactured part for which all cards have been completed in Steps 1 and 2 and cut summary cards for total material, total labor and total overhead.
4. Match summary cards against remaining material cards to complete costing of first stage sub-assemblies.
5. Tabulate sub-assemblies costs, cut summary cards, and match against remaining material cards to complete costing of second stage sub-assemblies. Repeat this process until costing is complete.

Cost Standard Sheet

Part description: Frame support Part No.: 570123

Account or cost center	Standard hours	Material used	Unit Cost: Purch. mat'l	Inter-plant mat'l	Labor	Overhead
620	1/8 x 4 x 6 C. R. Steel	1.15#	.203			.051
10	.100				.300	.900
12	.200				.650	1.950
			.203		.950	1.901
				Total		4.054

EXHIBIT 4

The completely costed route sheet deck, together with cards containing a brief description, are now used to run cost standard sheets on an I.B.M. 407 or 402 accounting machine. Exhibit 4 is an example of a cost standard sheet for a simple manufactured part. Exhibit 5 is an example of a cost standard sheet for a first stage sub-assembly which has as a component the part shown in Exhibit 4. Summary cards are cut while running these sheets and added to the cost standard deck.

Standards for final models are set in three steps:

1. Punch into cards from a bill of material for each model the model number, part number, quantity used, final sub-assembly number where the part is added, and a code indicating whether the part is common to all variations in the basic model or is used only on certain variations.
2. Match the cards punched in Step 1 against the cost standard deck to obtain the unit costs and account number. This cost standard deck is made up of cards punched from the ready-for-use standards set up by purchasing, manufactured parts summary cards, and standards received from supplier divisions covering parts manufactured by them for use in our models.
3. Extend the unit standards by the quantity used and the material overhead rate, list in bill of material order, and finally summarize by account number. Exhibit 6 is an example of a model cost sheet prepared by the cost department from the tabulated model summary and after the manual addition of the overall overhead rate.

Cost Standard Sheet

Part description: Lift frame member assy. Part No.: 671121

Account cost center	Standard hours	Material used		Unit Cost: Purch.	Mat'l	Inter-plant mat'l	Labor	Overhead
666*		570123		1.	.203		.950	2.901
832		899101	*	1.		2.000		.340
20	.025						.063	.252
21	.050						.138	.276
					.203	2.000	1.151	3.769

* Manufactured parts account — Total 7.123

EXHIBIT 5

This discussion is not meant to be a technical description of tabulating procedures. Many of the steps require additional tabulating operations and proof techniques which must be programmed by the tabulating supervisor, working closely with the accountant. It should be pointed out, too, that, along the way, many hours of manual checking are put in by the cost department to verify the general accuracy of the results. The cost department must also run down the exceptions and unmatched parts which crop up at almost every step.

Accounting for Overhead in Interim Periods

Ordinarily a physical inventory is taken at the beginning of each new standards year. This inventory is priced at the new standards. The standard overhead-in-process account is then adjusted to the sum of the overhead portion of

the physical inventory of manufactured parts plus the overhead portion of partly completed parts and assemblies. Each month thereafter, this account is charged with overhead absorbed from four sources:

1. Overhead applied to standard labor dollars by department at the rates computed in Exhibit 2.
2. Overhead rates applied to ready-for-use and inter-plant material consumed, priced at standard.
3. Overall overhead applied to the total standard cost of all complete models finished during the month.
4. Adjustments for variances arising from the substitution of finished parts for ready-for-use parts.

Standard overhead in process is relieved from four principal sources, also:

1. The overhead portion of the standard cost of complete models transferred to finished goods. This is computed by multiplying the total unit overhead ($1,645.33 in the example of Exhibit 6) by the number of each model built during the month.
2. The overhead portion of finished parts shipped directly from work-in-process to customers or other divisions. This is obtained automatically from tabulations of material transfer orders to other divisions and of the cost of sales to customers.
3. The overhead portion of the cost of parts scrapped.
4. The overhead portion of reduced parts or model costs arising from improvements in methods or substitutions of parts.

Summary of Model Cost

	Account	Purch. mat'l	Inter-plant mat'l	Labor	Overhead
Purchased materials	620	$ 20.00	$	$	5.00
	621	40.00			10.00
	622	50.00			12.50
	625	100.00			25.00
Inter-plant materials	820		5.00		.85
	822		100.00		17.00
	825		700.00		119.00
	830		10.00		1.70
	832		10.00		1.70
Manufactured parts	666	800.00	50.00	200.00	958.00
Assembly, labor and overhead	32			60.00	150.00
Sub-total		$1,010.00	$ 875.00	$260.00	$1,300.75
Overall overhead					344.58
					$1,645.33
Total standard cost before overall overhead					$3,445.33
Total standard cost after overall overhead					$3,790.33

EXHIBIT 6

Advantages of the Pool Overhead System

The pool method of accounting for overhead is a system tailor-made for the plant which makes large-scale use of both ready-for-use materials and parts manufactured within the plant in the assembly of its products. In any company, where either material-related or management policy costs constitute a significant portion of the total overhead pool, some adaptations of this method can prove valuable. As previously stated, the principal objective of this method of charging overhead to product is the development of product standard costs which are comparable. Other advantages are:

1. Cost center overhead rates include only overhead expenses which are directly allocable to the conversion activities carried on within the cost center. This facilitates comparisons of finished part costs with purchase quotations and also makes it possible to intelligently compare costs in similar departments of different plants.
2. The effect of engineering, development, warranty expense and various management option costs can be expressed in terms of their effect on unit profitability. This can be a valuable guide in planning the level of these expenses. During the course of the year, as actual volume exceeds or falls short of forecasts, unit cost analysis can be presented to management to show the current effect of optional programs.
3. Measurement of purchasing, production control, and material handling and storage departments in terms of cost per dollar purchased or handled can be made an automatic by-product of overhead studies and monthly reporting.
4. Costs of parts manufactured for service will not bear a part of the costs applicable to the development of new products, product improvement, and warranty expense. Parts purchased for service will bear their share of procurement, handling and storage costs.
5. Analysis of under-absorbed overhead will readily indicate poor cost performance in production areas and in material related costs.

State Taxation of Interstate Commerce

by PAUL D. SEGHERS*

AN ACT (S-2524), which has recently been approved by President Eisenhower, should be of considerable interest to all accountants. This Act, signed on September 14th, prohibits certain forms of state taxation on what is really interstate commerce. It prohibits any state imposing a "net income tax" on income derived within such state from interstate commerce (a) if the only business activity of the person deriving the income within the state is the solicitation of orders for the sale of tangible personal property which are sent outside the state for approval or rejection, and, if approved, are filled by shipment or delivery from a point outside the state, and (b) if such person is not a corporation organized under the laws of the state or an individual domiciled in or resident of such state.

"Net income tax" is defined to mean any tax imposed on or measured by net income.

The law also prevents retroactive state taxation by prohibiting the assessment of net income taxes of the kind or type protected under the Act imposed for any taxable year ending on or before the date of enactment of the Act (September 14, 1959). However, the Act does not invalidate the collection of net income taxes on or before September 14, 1959, if the tax was imposed for a taxable year ending on or before that date. The Act also permits the state to collect net income taxes after that date, if assessed on or before that date.

Under the Act, a state cannot solely by reason of sales activities by independent contractors on behalf of a person, subject such person to state income tax on income arising out of interstate commerce.

The Act directs the House Judiciary Committee and the Senate Finance Committee to conduct a study to consider all matters pertaining to taxation by the states of income (not limited to income from the sale of tangible personal property) derived from the conduct of business activities which are exclusively in furtherance of interstate commerce or which are a part of interstate commerce. These committees are instructed to report to Congress, on or before July 1, 1962, with proposals for legislation. The Act, itself, carries no termination date and thus represents permanent legislation.

This Act is of tremendous importance, not only because it will relieve manufacturers from state income taxes on income from future sales but also because it bars assessment of taxes against sales made in the past. Such assessments, which might include interest and/or penalties, are now barred if they were not made on or before the 14th of September, 1959.

While the Act does not solve all problems in this field, it will nevertheless have a profound effect upon all businesses making nation-wide sales.

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Setting Up and Reporting Standard Costs in Small Branch Plants

by RICHARD D. ROSENBERG

MUCH HAS BEEN WRITTEN on standard costs and considerable material on this subject has appeared in the *N.A.A. Bulletin*. However, the complexity and degree of detail involved in standard cost systems has, for the most part, confined such systems to larger units in industry, and the related literature has been slanted accordingly. For this reason, we wish to present here a specialized phase of standard cost accounting.

Small independent plants are usually content to rely on product cost estimates prepared as a basis for price quotations and financial statements. In such cases, the active management is usually so familiar with operating details that adequate control may be achieved without a highly developed cost and reporting system. The control function is, therefore, often synonymous with ownership and ultimate profit responsibility. In the case of small manufacturing units which form part of larger industrial groups, we are presented with an apparent anomaly. Here we have a small plant possessing a limited accounting and control staff, operating with an expense budget, and frequently incapable of absorbing the cost of additional personnel. On the other hand, overall operating responsibility extends beyond the plant manager to an operating division or company-wide executive, very often quite remote from the plant and not familiar with its day-to-day operations. Such executives, who assume profit responsibility, must be given adequate and timely cost and operating data to be able to:

1. Evaluate performance of the plant manager.
2. Compare operating results with similar branch operations or other activities within the group.
3. Supervise pricing policies, where this is handled on a local basis.
4. Forecast results with reasonable accuracy.

Preliminary Steps Required

Our particular company operates a number of such small geographically dis-

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persed units, located in the United States and abroad. The writer has participated in setting up standard cost systems to provide the information indicated and to do so with a limited number of accounting personnel, generally not more than three in a plant of approximately 100 employees. These three individuals cover all phases of budgeting, materials control, standard costs, payroll and labor distribution, in addition to general and sales accounting and billing, and general personnel functions. Operating of such a system requires the following:

1. Establishing simple unit standard costs through—
   a. Determination of annual sales and production budgets.
   b. Setting up labor establishments on a departmental basis to meet such production estimates.
   c. Determination of anticipated factory expenses.
   d. Setting up standard material specifications and costs.
   e. Analysis of departmental labor content in each product.
   f. Distribution of factory expense on a production department basis and the calculation of departmental burden rates.
2. Taking a monthly physical inventory of goods in process.
3. Submission of a series of monthly cost, financial and operating reports, comprehensive in their scope yet simple to prepare.

Sales Budgets; Direct Labor Estimates

Annual sales budgets converted to production units are achieved after discussion with and interrogation of the plant manager and responsible sales personnel. Care is exercised to ensure that such estimates are attainable from the standpoint of production facilities and available plant personnel.

Our plants are engaged in the manufacture of a wide variety of products, in some cases utilizing common production equipment and facilities, while in others they are completely unrelated. Due to limitations of size, there is usually no time-study staff, and detailed labor standards for use in developing unit direct labor costs are frequently unavailable. For this reason, the calculation of direct labor costs must be handled on a different basis. This is accomplished as follows:

1. In conjunction with the factory manager and general foreman, a departmentalized direct labor "establishment" is prepared and the total production labor payroll is calculated on the basis of effective labor rates. The individual departmental labor totals are corrected to allow for known indirect labor items, such as rest

periods, etc., by applying predetermined percentages to the total department labor.

2. No attempt is made to allow for setups, a step which would refine the departmental direct labor figures. In practice, deficiencies in reporting setups have resulted in negative direct labor variances and corresponding gains in the indirect labor accounts.
3. Where possible, unit labor values are calculated on a weight, lineal, area or volume measurement basis, or a combination of these, by dividing the net departmental direct labor by the total weight or area or volume passing through the department, adjusted for variations in feeds or speeds between the different stocks.
4. Where possible, unit operation times are estimated, using known machine times or previous output experience.
5. In the final step, the unit labor content in each product, calculated by the methods described, is extended by the budgeted volume, and the results are compared with the total departmental labor schedules. Substantial differences between the budgeted direct labor cost and the anticipated direct labor recovery are adjusted by a proportion in the standards, even though this means incorporation of inefficiencies and lost time into the standard. It is the function of the plant cost accountant to ensure that the direct labor establishment represents the minimum force capable of producing the budgeted production under reasonable operating conditions, in order to keep these adjustments to a minimum.

Factory Expense; Departmental Burden Rates

Factory expense accounts are collected and analyzed on a month-to-month basis to determine their fixed or variable nature. We have developed a combination form (Exhibit 1) which serves as a factory expense ledger and flexible budget sheet, and permits accumulation of actual expense and variance. Our experience indicates that fixed expense usually accounts for between 75 and 85 percent of the total factory expense in the small plants. Indirect labor categories and fixed charges such as depreciation, rentals and insurance are budgeted on the basis of scheduled expense. Miscellaneous items such as small tools and supplies, maintenance supplies, entertainment allowances, etc. are budgeted on an average actual experience basis with a review of such items where abnormal expenses may have occurred.

Expenses are directly allocated to the department in which the expense is incurred or would actually be incurred. Where this is not possible, past experience is used as the basis of allocation. In the case of maintenance labor, the

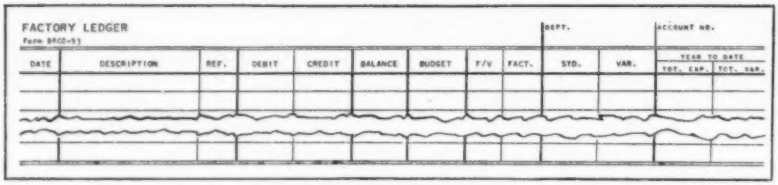

EXHIBIT 1

actual charges by various account classifications (building maintenance, machinery maintenance, mold maintenance, furniture and fixture maintenance, etc.) for the previous year (or more, if available) are compared on a percentage basis and these percentages applied against the maintenance department labor establishment total cost. The actual charges by department within each maintenance labor account category are similarly compared and these percentages applied against the amount budgeted for each account, as indicated above. Such charges as steam and electricity are broken down between general heating and demand charges respectively (which are fixed), and process or usage portions (which are variable).

After analysis of variability, budgeted variable expenses are calculated. Where there is a direct and known physical relationship suitable for mathematical expression or graphical prediction, it is employed, although this may at times require certain assumptions on the part of the budgeter. It has been our experience that budgeting within 10 percent of actual expense, even when based on such unscientific methods, is easily possible and, over a period of two or three years, the variation can be brought to within 3 percent.

Upon completion of the departmental budgets the total expenditure for each service department is allocated to the production departments as follows:

1. General items (building costs, principally)—area basis.
2. Plant protection and safety (watchmen)—area basis.
3. Janitors—area basis.
4. Power house costs for heat—area basis.
5. General plant supervision—direct labor.
6. Factory accounting—direct labor.
7. Laboratory—direct labor.
8. Electric energy and process steam—(distribution by schedule set up by plant engineer).
9. Engineering and maintenance—actually experienced repair and maintenance labor.
10. Receiving and storage—budgeted tonnage to end product.

Total factory expense, allocated or charged directly to the production departments, is compared with budgeted direct labor (by establishment) to arrive at departmental burden rates which are then applied against operation direct labor values in the unit costs, to arrive at unit overhead content.

Goods-In-Process Inventories; Production Variances

One of the principal elements of the system used is the taking of a physical goods-in-process inventory each month. With some experience, this can be completed accurately during working time by departmental teams and without excessive cost. It eliminates extensive interdepartmental transfer reports and, consequently, requires only the materials requisitions, labor time tickets and load slips to cover the relief of finished goods from production. The load slips also form the basis for daily production reports. Furthermore, the monthly physical inventory ensures that physical discrepancies caused by excess scrap, usage, or waste are disclosed at the time of their occurrence and are not permitted to compound themselves into year-end surprises. The unit Standard Cost Sheet (Exhibit 2), which permits accumulation of cost at each process step, greatly facilitates rapid valuation of work in process.

Standard Cost Sheet

Serial No. _____
Date _____

Product _____ Manufacturers No. _____ Our No. _____

Specification No. _____
Description _____

Material
Unit weight _____
Unit cost (net) _____
Process allowance _____
$ _____

Labour	Amount	Overhead Rate	Overhead	Cumulative Materials	Cumulative Labour	Cumulative Overhead	Cumulative Total
	$		$	$	$	$	$

EXHIBIT 2

Material, labor and factory expense are then processed through the production departments in order to arrive at actual costs of production, which are compared with standard relief by product to obtain production variances by products.

Since raw materials are inventoried at standard cost, price variances are picked up at the time of entry. Therefore, the variance for material is entirely usage and can be explained through the scrap, waste and other machine material production reports. No attempt is made to segregate labor variances into rate and efficiency components. Variable overhead items are adjusted for activity (standard direct labor for actual production divided by standard direct labor for standard production) and expenditure variance is calculated. Total expenditure variances by department are similarly progressed through the end products in proportion to the labor progression and, after the unabsorbed overhead is found, by eliminating the product overhead expenditure variance from the total actual product overhead excess over standard relief.

A Set of Reports Completes the Picture

Based on these preliminary steps, a monthly report is prepared, consisting of the following:

1. Result of operations compared with budget, monthly and cumulative.
2. Balance sheet.
3. Gross profit by product.
4. Cost of production by product, showing cost element variances monthly and cumulatively.
5. Factory expense by account classification, showing standard expense, actual expense and variance for the month, and total expense and total variance for the year-to-date.
6. Factory expense by departments, presented in the same manner as the account classifications.
7. A summary report of scheduled, standard, and actual production, production recoveries, and production rejects by product.
8. A summary of standard and actual material process waste by product, expressed in percentages and money values.
9. A report of budgeted and actual personnel by department.

To be of value, the reports must be timely. We require teletyped reports (cabled in the case of overseas plants) on the following time schedule:

1. 1st day of month—Actual sales by product for the previous month.
2. 5th day of month—Estimated operating profit.
3. 7th day of month—Actual labor and material variances for the previous month.
4. 10th day of month—Total overhead variance and principal overhead variance accounts.
5. 13th day of month—Net profit for the previous month.

We also require that the full set of reports be mailed not later than the fifteenth day of the month. Together with weekly reports of production, rejects, process waste, overtime, sales, shipments and personnel, these monthly reports give us at home base a continuous picture of operations and advance warning of problems. This helps to anticipate solutions. While the system is orthodox in its approach to standard cost system operation, we feel its adaptation to small unit limited staff operations has filled a distinct void, and is a sound basis for major policy decisions by management. This, after all, is its designed purpose.

The "Diminished" Dollar — A Word in Its Favor

by NICOLAS A. SALAZAR*

THE ARTICLE ENTITLED, "Those Diminished Dollars in Fixed Asset Costs," by W. A. Sills, which appeared in the *N.A.A. Bulletin* of June 1959, Section 1, was read with a great deal of interest, since this subject of diminished dollars is, in my opinion, one of the great fallacies of our age. The author points out that we are prone to resist change, especially when change affects such an intimate part of our selves as our ideas and convictions. No one would be so rash as to challenge this. The basic point is that we are set in our ways of thinking and accept many misconceptions as a fact just because it would never occur to us to challenge them. The mere thought that the dollar of today is not as powerful as its predecessors or that it is worth only 60¢ or that its purchasing power has deteriorated seems to me to be so ridiculous that it is *prima facie* evidence that we prefer to accept and not analyze. I would like to state here and now that the dollar of today is infinitely more powerful than it ever was and is becoming more powerful every day.

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The entire concept of diminished dollars and inflation has come about by the constant misinterpretation of the Consumer Price Index. It is said that when the general level of prices as reported on the Consumer Price Index increases we have inflation and that the dollar has decreased in value and, conversely, a decrease in deflation and the dollar value increases. In my estimation it is really amazing that this erroneous interpretation of the index has been going on for so long and has been accepted at face value by so many people.

The fact is that the Consumer Price Index is nothing more than what it says it is, an index of prices. It is concerned with only one side of the ledger, the amount of dollars the consumer must pay in order to receive the articles, he wishes to obtain. What about the other side of the ledger? How many 1939 dollars would be required in order to buy the following items, to mention but a few; penicillin injection, salk vaccine, a television set, or a four-day trip around the world? The index considers only the debit side, which is what it was designed to do. It is not and never will be a tool to measure the value of the dollar, nor is it an indication *per se* of inflation or deflation. Inflation occurs when the standard of living decreases while the cost of living increases. This situation certainly has not occurred in America, very much to the contrary. The standard of living in America has so greatly outstripped the cost of living as to make the entertainment of such an idea almost ridiculous. Also, a dollar diminishes in value when the cost per value received increases. Here again, some of the items which may be purchased today for a mere bagatelle in terms of 1959 dollars are so valuable that it would probably be impossible to calculate the actual value received.

The author talks about replacements and replacement costs. Do we ever really replace anything? The answer, of course, is "No, never." Technology takes care of that. It is said that we replace an old car with a new one or an old plant with a new. These statements are quite true. But what do they mean? They mean, of course, replacement with something new, different and better. They do not mean another product of the same design and performance.

It is my firm conviction that the dollar has a built-in stabilization factor which comes about as a result of technology and progress, and that the whole question of "diminished" dollars does not recognize these factors. Even if we were to stretch our imagination and erroneously adjust the dollar downwards on the basis of the Consumer Price Index, then we must again adjust the dollar upwards for the technological advancement between the periods being compared. This process would of course be impossible but would correct for the error of considering only half of the equation.

Standard Costs Are For Financial Statements

by ERNEST L. MOULAND*

THE ARTICLE in the April issue of the *N.A.A. Bulletin* by Stephen A. Zeff was very well presented and of considerable interest to me, although I was not entirely in agreement. The use of standard costs in financial statements, in practice, does not need to conflict with theoretical accounting concepts. It has been my experience that the use of standards in regular statements is far superior to any system of partial or "not-at-all" use. The following points are my arguments in favor of booking your standards.

First, one of the most important points in Mr. Zeff's article and one with which I am in complete agreement, is, "Executives will take standard costs and variances more seriously". This is so true and, after all, what are accountants for, if not to present their statements in such a form that executives will sit up and take notice of something they can get their teeth into and use to their advantage. Standard cost and variances, presented in other than financial statement form, tend to get full use and treatment from the manufacturing executives in their cost control programs. However, they do not get proper attention from general or top corporation executives who are more inclined to use the official financial statements as a guide and ignore the supporting variance reports. To a degree it is actually a waste to install and make work an elaborate and good standard cost system and then not use it to its full advantage.

Secondly, all accountants will agree that successful standards must be realistic yet tight. Once this has been established, there are only two possible results in anything resembling normal operating levels. The variances from standard will most often be unfavorable and they will not be excessively large, at least not in all cost centers or accounts at once. One might now say, "what about unusual conditions which may arise during the life of a standard cost?" If material prices, labor rates, business conditions or even burden rates change seriously and begin to cause variances which do considerably distort the financial statements, it is a relatively simple matter for the accountant to create reserve or valuation accounts in his inventory records. Being on standards, he knows what the standard material, labor, and burden content of his inventories are and can for any statement period make an adjustment for any or all variances

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which he feels will more accurately present current profit. This simple entry can be left in the inventory for the duration of the emergency or can be reversed and re-entered in each period to reflect the current picture. There is no doubt that such a procedure, used in conjunction with a well founded standard cost system, can translate inventories from standard to within decimal points of an actual costed physical.

Third, in Mr. Zeff's article, no mention was made of the difference between interim and closing statements. Surely, except in unusual variance circumstances mentioned above, a good standard cost system will reflect accurate and reliable information in the interim or monthly statements. Where this is doubtful, the adjustment procedure can be utilized. I cannot agree that there should be difficulties in finding satisfactory bases of apportionment of variances. The inventory at standard is used (very successfully) in pre-closing work to determine physical shortages in inventory and from that point the inventory ceases to be quoted at standard.

In fact, this is just one more advantage of a standard cost system, that there is no better way of measuring actual cost than by regularly comparing it to a norm. Adjustments to actual from variances can even be made more accurate by measuring variance rates over the last months of the year or any period which logically covers the period of time represented in the inventory. Adjusting inventory at standard to actual should be made on a simple theory, similar to Newton's "what goes up must come down." When the cost were applied it was: Standard = Actual ± Variances; and for the closing statements the equation becomes: Actual = Standard ± Variances.

Summarizing, I cannot believe that standard costs are found in financial statements today as a result of "practical necessities" and not "theoretical blessing." Opening and final closing statements of a company are always expressed at actual or lower under any system and interim use of standards and all their advantages does not preclude the possibility of satisfying all the theories which one wishes to apply, if done by a modern accountant with an alert system and "eyes open" technique.

Beyond These Covers

Books

A Technical Writer's Handbook

Margaret Norgaard, Harper & Brothers, 49 East 33rd Street, New York 16, N. Y., 1959, 241 pp., $3.75.

Specified for "technicians, engineers, educators, businessmen, and scientists", this book is surely one for the accountant, whose product is embodied in text and tables. Such topics as grammatical errors, punctuation, and abbreviations are followed by chapters on "Words and Their Meaning", "Logic and Style", and "Creation of the Interest Factor."

Developing a Product Strategy

Elizabeth Marting, Editor, American Management Association, 1515 Broadway, Times Square, New York 36, N. Y., 1959, 352 pp., Paper Bound, $7.50.

Some 35 contributors have provided chapters or chapter portions for this book. These contributions are sectionalized under headings of "Planning and Organization", "Research and Exploration", "The Product Screening Process", "From Engineering to Production", "Marketing Plans and Procedures", and "Financial Requirements". The contents of the last-named section is recapitulated by George J. Wachholz under the title of "Fundamental Factors in Calculating the Cost of Potential New Products."

The Compensation of Salesmen

Dartnell Corporation, Ravenswood and Leland Aves., Chicago 40, Ill., 1959, Loose-leaf.

This is a comprehensive ten-section survey relating to the following subtopics (among others): current levels of pay, salary and bonus plans, compensation by commission, fringe benefits for salesmen, incentive plans, and expense account practices. Throughout, the survey endeavors to give "factual data on how others are meeting the many problems involved in sales compensation."

Business Experience With Electronic Computers

Conway, Waltz & Gibbons, Controllership Foundation, 2 Park Avenue, New York 16, N. Y., 1959, $5.

On an active topic of discussion, this analysis and report, prepared by members of the management advisory staff of a large public accounting firm, is "aimed principally at those who have been assigned responsibility for making the initial decision and for planning, supervision, control and ultimate success of the electronics program itself." Preparation, installation and operation of electronic equipment are dealt with. The book is subtitled, "a synthesis of what has been learned from electronic data processing installations."

Institute on Accounting

University of Colorado, Boulder, Colorado, 1959, Paper Bound, 94 pp.

A rather broad range of topics was considered at last spring's sixth Annual Institute on Accounting of the University of Colorado and are reported in the proceedings now published. "The Broadening Scope of Controllership", "Economic and Accounting Aspects of Leasing" and "The Accountant and His Managerial Future" are three of the six address titles.

Linear Programming

Saul I. Gass, McGraw-Hill Book Co., 330 West 42nd Street, New York 36, New York, 1958, 223 pp., $6.75.

Further characterized by the subtitle "Methods and Applications", this introductory text on a now well-known but not widely understood technique starts off with the mathematics needed and proceeds to theoretical and computational methods before going on to applications in transportation, production scheduling, inventory control, inter-industry problems, etc.

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